

## CHAPTER 2

### BASIC EQUIPMENT

#### Overview

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##### Introduction

The environment of the Navy Drafting shop directly reflects the vitality of the shop and the abilities of the personnel assigned to it. It sets the mood for creativity and productivity. Cleanliness, availability of supplies, and equipment readiness are important to the environment of the shop and affects the way a customer perceives the professional knowledge and capabilities of personnel.

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##### Objectives

The material in this chapter enables you to do the following:

- Ž Identify the angles created by the use of the 30/60- and 90-degree triangles both alone and in combination.
  - Ž Differentiate between standard cased instruments and special-purpose instruments.
  - Ž Identify the steps in cleaning a technical pen with a reservoir.
  - Ž Select the appropriate lead hardness for a detailed technical drawing.
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## Overview, Continued

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**In this chapter** This chapter covers the following topics:

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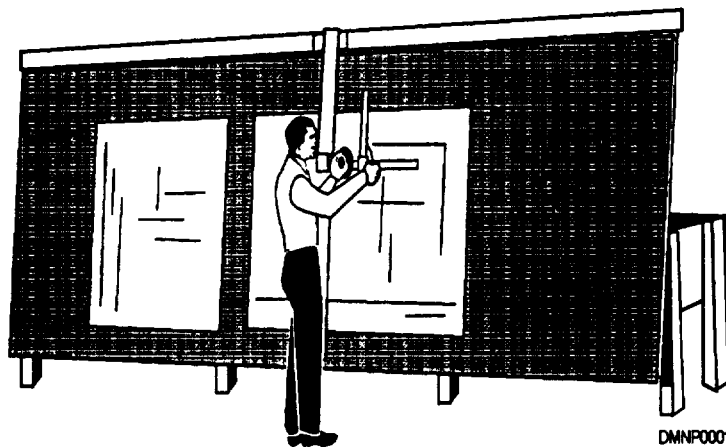
## Furniture

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<b>Introduction</b>	The name Illustrator Draftsman conjures up a visual image of a particular type of table and drawing instruments. However, a drafting table and a set of cased instruments are not all a DM has to work with. Along with the use of furniture and equipment is the responsibility of maintenance.
<b>General care</b>	Tables, straightedges, and other equipment that is common to drafting shops should be kept clean of debris and clutter. Periodically, clean them with mild detergent and rinse them well. Use a thinner or mineral spirits to remove adhesives and wax. Keep tables and straightedges free of nicks and lacerations. Carefully adjust tables and chairs for comfort in sitting or standing at work.
<b>Drafting tables</b>	Drafting tables come in a variety of shapes and sizes. Most tables have a height and a tilt adjustment. The trend is toward modular systems with an adjoining worktable. Do not cut against the drafting table. Make it a practice to cover the drafting tabletop and change the cover when it becomes soiled or unserviceable.

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Figure 2-1 shows a large drafting table.



**Figure 2-1. —A large drafting table with a roller-type drafting machine.**

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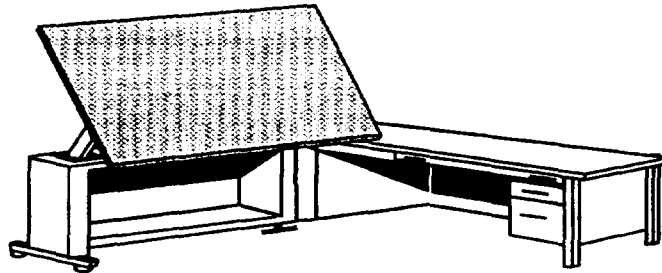
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## **Furniture, Continued**

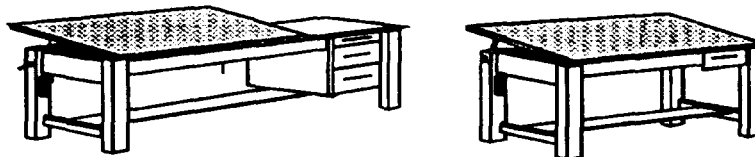
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### **Drafting tables (Continued)**

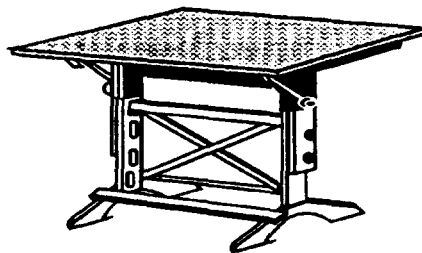
Figure 2-2 shows many types of drafting tables.



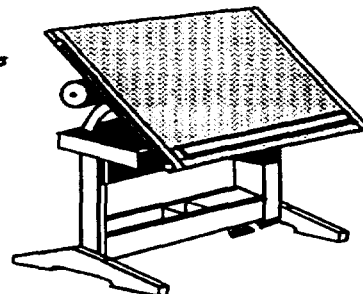
**L-SHAPED DRAFTING TABLE AND REFERENCE DESK. THE DRAWING BOARD IS ADJUSTABLE TO ANY ANGLE.**



**DRAFTING TABLES WITH ADJUSTABLE DRAWING BOARDS THAT MAY BE TILTED UP TO A MAXIMUM OF 45°. TABLE SHOWN ON THE LEFT ALSO HAS A FLAT SURFACE FOR TOOLS OR REFERENCE MATERIAL.**



**PEDESTAL DRAFTING TABLE**



**FRENCH TABLE  
ADJUSTABLE TO ANY  
ANGLE FROM HORIZONTAL  
TO VERTICAL.**

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**Figure 2-2. —Drafting tables.**

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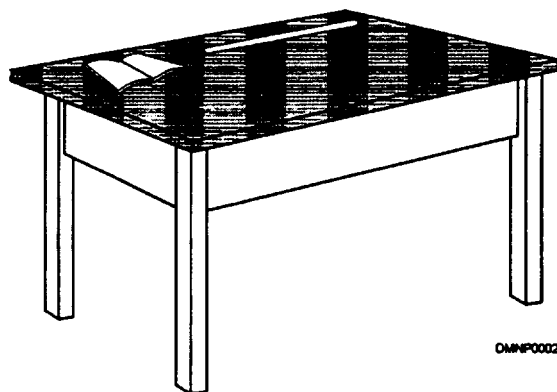
## **Furniture, Continued**

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### **Worktables**

Worktables are large, flat tables used to spread out additional reference material or equipment. Cutting may be done on this table provided you cover it with cardboard or vinyl. Besides protecting the tabletop, the covering prevents the blade from snapping or slipping across the table.

Figure 2-3 shows a typical worktable.



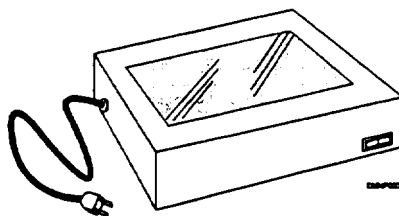
**Figure 2-3. —A work table.**

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### **Light tables**

Light tables may be small and portable, or as large as a drafting table. Illuminated from underneath, they allow a worker to see through paper and trace an image. They are invaluable for aligning transparencies or in color separation work. Never cut against a light table as this will scar the glass surface. Furthermore, do not lean against or on top of a glass tabletop.

Figure 2-4 shows a portable light table.



**Figure 2-4. —A light table.**

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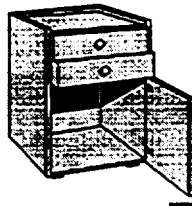
## Furniture, Continued

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### Tabourets

Tabourets are small, portable work stations that contain some storage in the bottom and a small drawer. They are useful when a job requires a temporary work station at a remote location away from the shop.

Figure 2-5 shows a two drawer tabouret.



**Figure 2-5.**  
**—A tabouret.**

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### Table coverings

A table covering protects the table from damage and wear. It smooths over existing damage to the drawing surface and changes easily when it becomes soiled or unserviceable.

The following table shows four table coverings and their advantages:

Material	Advantage
Cellulose acetate paper	Ž resin coated Ž short-term protection Ž maybe gridded
vinyl	Ž long lasting Ž self sealing Ž most popular Ž available as translucent for light tables
Mylar	Ž long lasting Ž dimensionally stable
Cork	Ž permanent Ž use on badly scarred tabletops

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## Furniture, Continued

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**Table coverings** Apply new table coverings periodically and according to the following  
(Continued) procedures:

Cellulose acetate paper

Step	Action
1	Roll out and cut paper to fit table.
2	Wet paper and place on table.
3	Tape around table edges.
4	Paper will expand when wet and shrink when dry to fit tabletop.

CAUTION: This type of covering may snap smaller drafting tables or tables not reinforced with internal rods.

Vinyl and Mylar

Step	Action
1	Roll out and cut vinyl/Mylar slightly larger than tabletop.
2	Allow vinyl/Mylar to lie flat for 24 hours before applying.
3	Lay vinyl/Mylar on table and trim to size.
4	Tape to table across the top of board only.

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## **Furniture, Continued**

### **Table coverings (Continued)**

#### **Cork**

<b>Step</b>	<b>Action</b>
1	Roll out and cut cork slightly larger than tabletop.
2	Apply glue to tabletop and cork back.
3	Allow glue to dry.
4	Placing paper over the glued back of the cork, gently roll cork up.
5	Position cork roll carefully over one end of the table and unroll over tabletop.
6	Gradually slide paper out from under cork while applying pressure.
7	Trim to size.
8	Cover tabletop with additional cover of cellulose acetate paper, vinyl, or Mylar.

### **Chairs**

There are many types and styles of chairs in the supply system through Government Supply Agency (GSA) contract. You will spend a great deal of time in this chair at the drafting table so make sure it is comfortable. It should be adjustable in height and tilt. Whether it has arms or rollers is a personal preference.

### **Lighting**

Natural lighting is the best type for drawing; however, it is not always available. Overhead lighting is usually the fluorescent type and not bright enough for drafting work. You need additional lighting attached to the tabletop to alleviate shadows and glare. These desk lights are available in many styles including a ring light around a magnifier for closeup work. Attach a desk light for a right-handed draftsman to the upper left corner of the table. For a left-handed DM, attach the desk light to the upper right corner of the table. Minimize shadows cast by the hand for they distract and distort visual perception.

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**Furniture, Continued**

**Waxers**

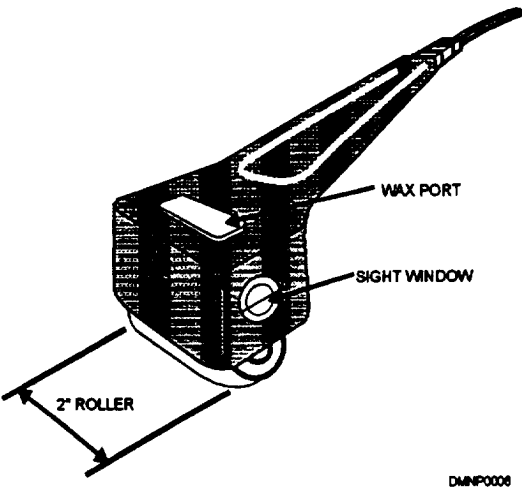
Waxers are machines that heat an adhesive wax substance to a liquid form and apply it in a thin layer. The two types of waxers are hand waxers and tabletop waxers. A hand waxer waxes a 2-inch-wide strip and a tabletop waxer waxes a full sheet of paper.

To use a hand waxer, follow this table:

Step	Action
1	Look at sight glass on the side of waxer.
2	Lift top cap to replace wax brick if low on wax.
3	Plug in waxer.
4	Wait 20 minutes or until wax flows easily from the roller.

CAUTION: Never overturn waxer once the wax is heated.

Figure 2-6 shows a hand-held waxer.



**Figure 2-6. —A hand waxer.**

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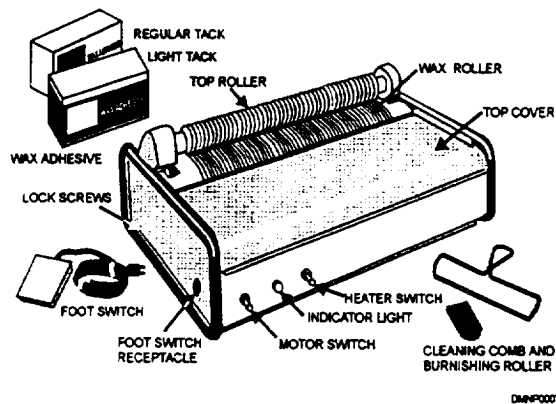
## Furniture, Continued

### Waxers (Continues)

To use a tabletop waxer, follow this table:

Step	Action
1	Make sure the machine is a minimum of one-third capacity full of wax.
2	Turn on the machine to medium setting.
3	Allow 30 minutes to heat wax evenly.
4	Run the material through waxer.
5	Run the material through waxer a second time and at a right angle to the first pass.
6	If wax does not appear as a light frost on the back of the material, adjust temperature setting.
7	Allow 20 minutes for waxer to heat wax evenly with new temperature.
8	Waxed material is repositionable until burnished into place.

Figure 2-7 shows a tabletop waxer.



**Figure 2-7. —A tabletop waxer.**

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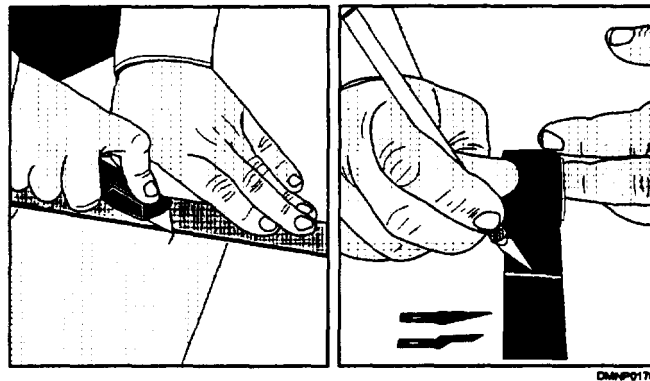
## Furniture, Continued

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### Mat cutters

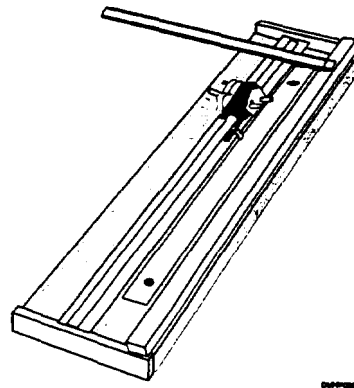
Another piece of equipment often found in drafting shops is a mat cutter. The two basic types of mat cutters are hand-held mat cutters and carriage units. Hand-cut mats require great skill and a steady hand. Carriage units ensure uniformity, speed, and accuracy. Carriage units cut oval, round, rectangular, square, and fancy cut mats. They may be large and mounted on a wall or they may be small tabletop units. Both types of mat cutters require a plentiful supply of fresh blades.

Figure 2-8 shows a mat being cut by hand.



**Figure 2-8. —Hand cutting a mat.**

Figure 2-9 shows a tabletop carriage unit.



**Figure 2-9. —A carriage-type mat cutter.**

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## **Furniture,** Continued

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### **Paper cutters**

The most abused tool in the shop is the paper cutter. Because of this abuse, do not trust the scale at the top of the cutter for accuracy. When you use the cutter, do not force it to cut more material than it can easily handle. Cut only paper or light cardstock. Paper cutters come in a variety of sizes with the most common measuring 36 inches in blade length.

To use a paper cutter, follow this table:

<b>Step</b>	<b>Action</b>
1	Measure and mark the piece to be cut.
2	Raise cutter arm.
3	Hold the piece firmly against top edge of cutter.
4	Draw cutting arm swiftly and cleanly down in one stroke.
5	If item is too large for one cut: Ž cut through item stopping short of the end by 5 inches, Ž rotate and reposition item to place uncut portion at the top of the cutter, and Ž carefully and firmly complete cut.
6	Replace arm in DOWN position and engage safety catch; failure to engage safety catch may result in the arm springing up and damaging the mechanism at the top of the cutter.

**CAUTION:** Never have a coworker assist by catching paper cuttings. Even a dull blade can sever skin.

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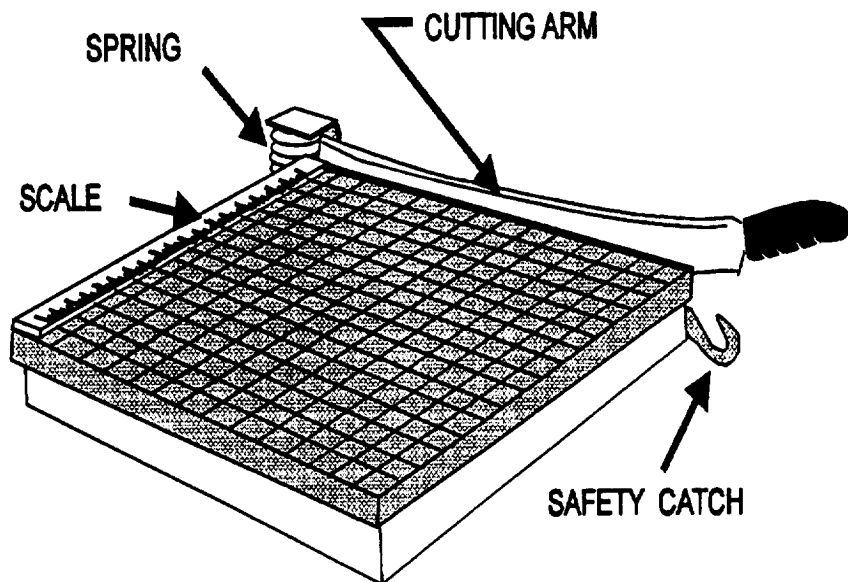
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## **Furniture, Continued**

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### **Paper cutter (Continued)**

Figure 2-10 shows the nomenclature of a paper cutter.



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**Figure 2-10. —A paper cutter.**

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### **Drafting machines**

A drafting machine combines the functions of a parallel ruler, a protractor, a scale, and a triangle into one piece of equipment. It is available for left-handed draftsmen. The five basic parts of a drafting machine are the protractor head, the scale mechanism, the removable scales, the linkage, and the table clamp.

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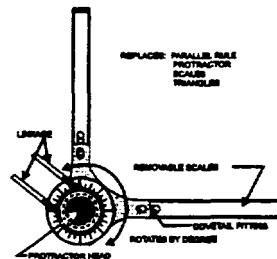
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## Furniture, Continued

### Drafting machines (Continued)

**PROTRACTOR HEAD:** The protractor head rotates by degrees allowing angle selection. A lock button secures the head at the selected angle. The head maintains a true angle throughout motion over the drawing surface. The protractor head houses the scale mechanism that holds the scales into place.

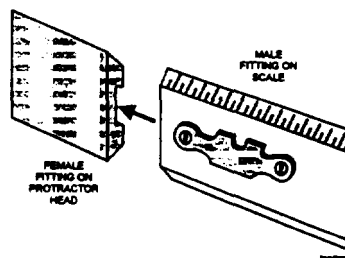
Figure 2-11 shows the location of the protractor head.



**Figure 2-11. —A drafting machine.**

**SCALE MECHANISM and REMOVABLE SCALES:** There are a variety of scales available for the drafting machine. Not only do scale faces vary, but so does the composition of the scale. Scales can be made of clear plastic, wood, or metal. Two removable scales attach to the scale mechanism at right angles to each other via male and female dovetail fittings. In fitting the scales to the mechanism, you should hear an audible click. An elongated slot on the mechanism allows minor angular adjustments to the scale. Do not force a scale into the fitting.

Figure 2-12 illustrates how dovetail fittings connect.



**Figure 2-12. —Dovetail fittings.**

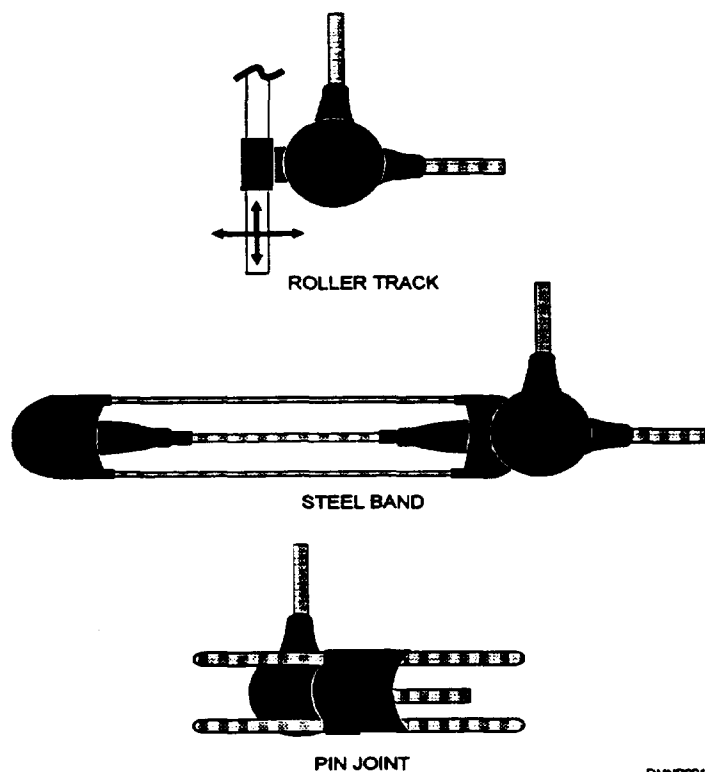
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## Furniture, Continued

### Drafting machines (Continued)

**LINKAGE:** The three most common linkages for a drafting machine are the pin joint, the steel band, and the roller. Because of the ability to adjust tension in the bands, steel band linkage is superior to pin joint linkage. Drafting machines with a roller linkage are advantageous when you are working on a large table or in a small space.

Figure 2-13 displays linkages most commonly found on drafting machines.



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**Figure 2-13. —Linkage types.**

**TABLE CLAMP:** The table clamp attaches the drafting machine to the table. Adjustments to the clearance and the position of the protractor head are made at the clamp.

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## Furniture, Continued

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### Parallel straightedges

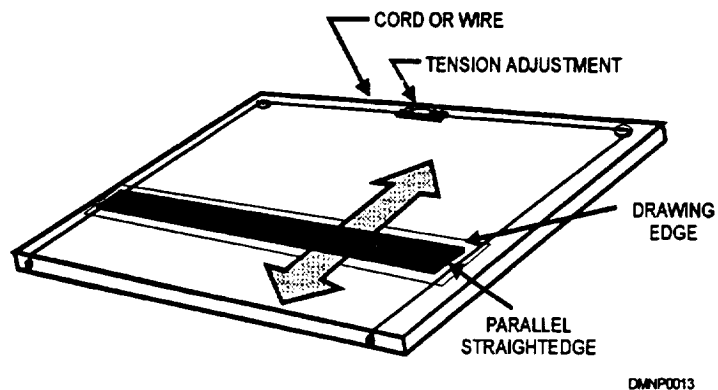
Parallel straightedges maintain parallel motion throughout their length. A system of cords and internal pulleys kept at moderate tension support the straightedge at both ends and allow travel up and down the tabletop. The cord used in a parallel straightedge may be fiber or coated wire. Straightedges are made in plastic, wood, or metal.

The major advantages of a parallel straightedge are as follows:

- Ž it is used by both left- and right-handed DMs,
- Ž it is easily restrung,
- Ž it is ideal when space is tight, and
- Ž it is simple to adjust and care for.

Keep the parallel straightedge clean, particularly underneath where it contacts with the paper surface. Periodically check the tension of the cord and adjust it as necessary. When the cord becomes frayed or kinked, restring the internal pulleys. Never cut against the edge of a straightedge.

Figure 2-14 shows a parallel straightedge with a tension adjuster.



**Figure 2-14. —A parallel straightedge.**

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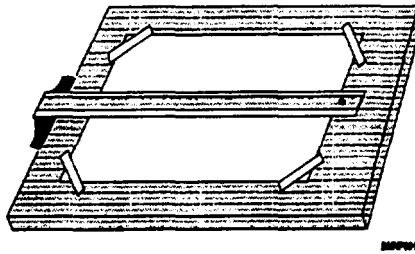
## Furniture, Continued

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### T-squares

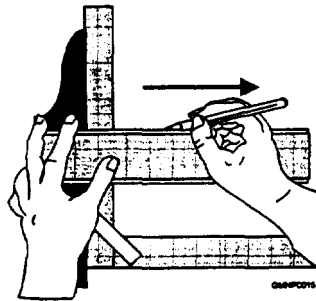
Use a T-square to draw straight, horizontal lines and to provide support for triangles when you draw lines at an angle. The two parts of a T-square are the blade and the head. The blade comes in different lengths and has a hole in the far end for hanging the T-square up for storage. The most popular blade length is 36 inches. The head mounts under the blade at a 90-degree angle and rests against the table edge. It guides the T-square in an up-and-down movement on the drawing surface. Because a T-square allows very little adjustment when it is damaged or out of true, throw it away and get another.

Figure 2-15 shows a T-square positioned on a drawing board.



**Figure 2-15. —A t-square on a drawing board.**

Figure 2-16 illustrates the direction for drawing horizontal lines against a T-square or straightedge.



**Figure 2-16. —Drawing horizontal lines with a T-square.**

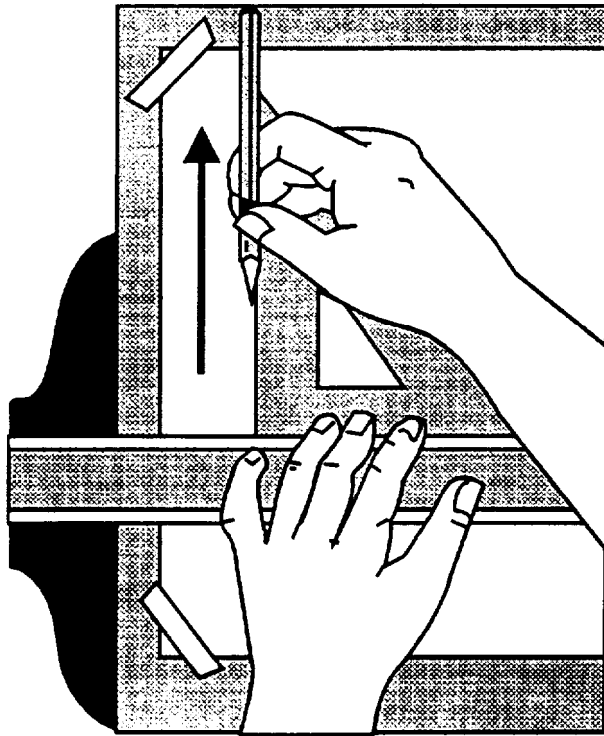
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## **Furniture, Continued**

### **T-squares (Continued)**

Figure 2-17 illustrates the direction in which vertical lines are drawn with a T-square or a straightedge.



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**Figure 2-17. —Drawing vertical lines with a t-square.**

### **Steel straightedges**

Draw or cut straight lines against a steel straightedge. Made of heavy gauge steel, they have the weight and strength needed to guide a blade under pressure. The cork on the bottom of the straightedge helps keep it in place. Some steel straightedges are beveled. Keep the straightedge clean and do not bend it out of true.

## Cased Instruments

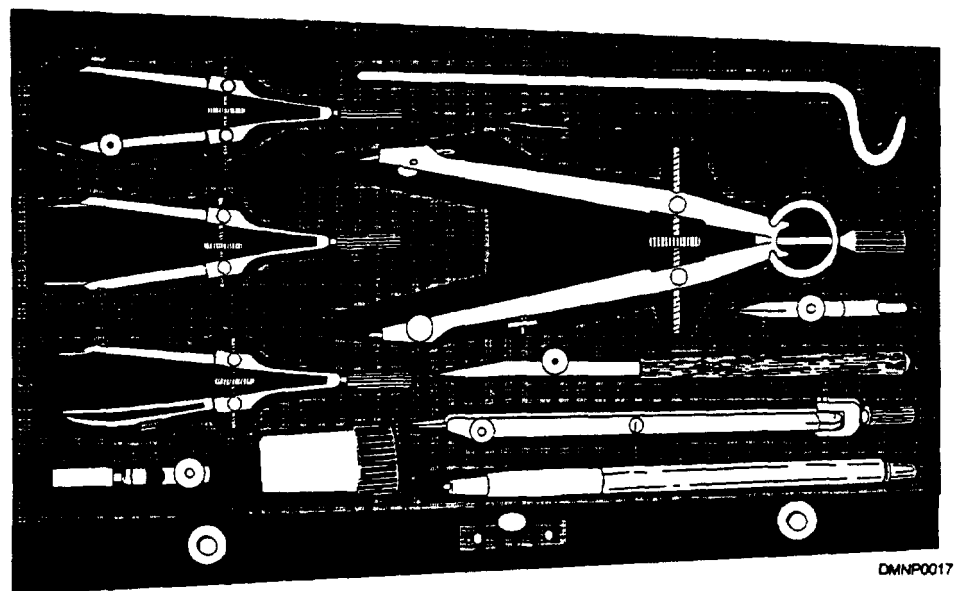
### Introduction

Cased instruments allow the draftsman to make precision drawings and maintain uniformity within the drawing. Quality tools improve the work. Use these tools for their intended purpose.

### Cases

Drafting instruments are delicate, precision drawing tools that require protection. Most instruments, even when purchased separately, come in their own case. This case protects the drawing tool. Many cases are impregnated with a rust or corrosive inhibitor to protect the drawing tools from the environment and atmosphere. Keep drafting instruments clean and put away when not in use.

Figure 2-18 shows a case full of clean, properly stored drafting instruments.



**Figure 2-18. —Drawing instruments in a protective case.**

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## Cased Instruments, Continued

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### Proportional dividers

Proportional dividers transfer measurements from one scale to another and divide lines and circles into equal parts. They consist of two legs of equal length joined by a moveable pivot. This pivot is a rack-and-gear movement secured by a thumb nut. There is a series of scales on the divider face ranging from 1 to 11.5. Divider points are made of hardened steel.

Protect divider points when they are not in use. Keep the dividers clean and wipe them with a light oil cloth after use. Do not oil the movement on proportional dividers.

Figure 2-19 shows a set of proportional dividers.

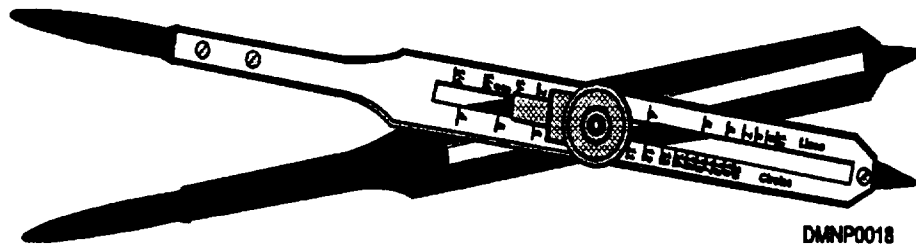


Figure 2-19. —Proportional dividers.

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### Dividers

Use a set of dividers to step off equal distances, to transfer measurements, or to divide a line into equal lengths. Dividers have two legs of equal length terminating in needlepoints. Above the needlepoints is a hinge to help the leg maintain perpendicularity with the drawing surface. Dividers are joined at the top.

Figure 2-20 shows a set of common dividers.

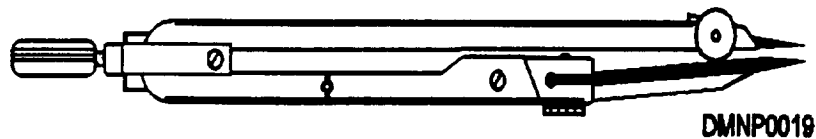


Figure 2-20. —Common dividers.

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## Cased Instruments, Continued

### Dividers (Continued)

To step off equal distances, follow this table:

Step	Action
1	Set dividers to a given distance.
2	Step off distance on drawing as many times as desired.

To transfer measurements, follow this table:

Step	Action
1	Set dividers to correct distance.
2	Transfer measurements to drawing.

To divide a line into equal lengths, follow this table:

Step	Action
1	Divide the line by the number of segments desired and approximate this distance with the dividers.
2	Step off this distance on the line.
3	Continue with trial and error until the distances are equal.

Figure 2-21 illustrates how to step off a line.



**Figure 2-2.**  
—Dividing a line  
into equal parts.

Protect divider points with cork or eraser bits when they are not in use. Clean dividers and wipe them with a light oil cloth before you return them to their case. Do not oil divider joints.

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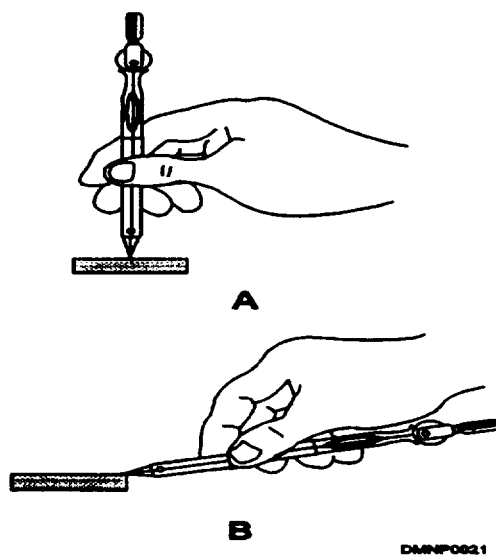
## Cased Instruments, Continued

### Dividers (Continued)

To sharpen divider points, follow this table:

Step	Action
1	Hold dividers vertically, legs together.
2	Grind lightly back and forth against an oilstone until even in length.
3	Hold the dividers horizontally.
4	Whet the outside back and forth while rolling it side to side between fingers.
5	Inside leg should remain flat and not be ground.
6	Remove all burrs and polish with a leather cloth.

Figure 2-22 illustrates the sharpening of divider points,



**Figure 2-22. —A. Evening legs of dividers. B. Sharpening divider points.**

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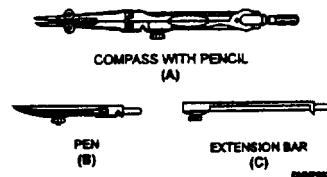
## Cased Instruments, Continued

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### Compasses

Use a compass to draw arcs and circles. A standard compass is 6 inches long and it has two legs. One leg holds the needlepoint and the other leg holds the nib. The nib may be a pen nib, a pencil attachment, or another needlepoint. The legs are often jointed above the nib to maintain perpendicularity to the drawing surface. The joint also reduces uneven wear and friction to the nib. To draw a circle larger than 12 inches, add an extension bar at the joint.

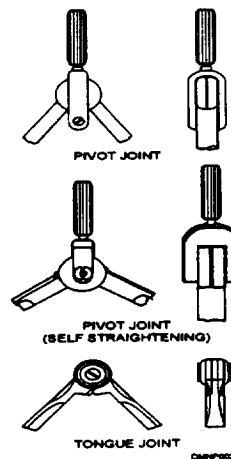
Figure 2-23 shows a pivot joint compass.



**Figure 2-23. —A pivot joint compass.**

The type of hinge on a standard compass indicates the quality of the instrument and its ability to hold a set. There are three types of hinges.

Figure 2-24 depicts the three types of compass hinges.



**Figure 2-24.  
-Compass joints.**

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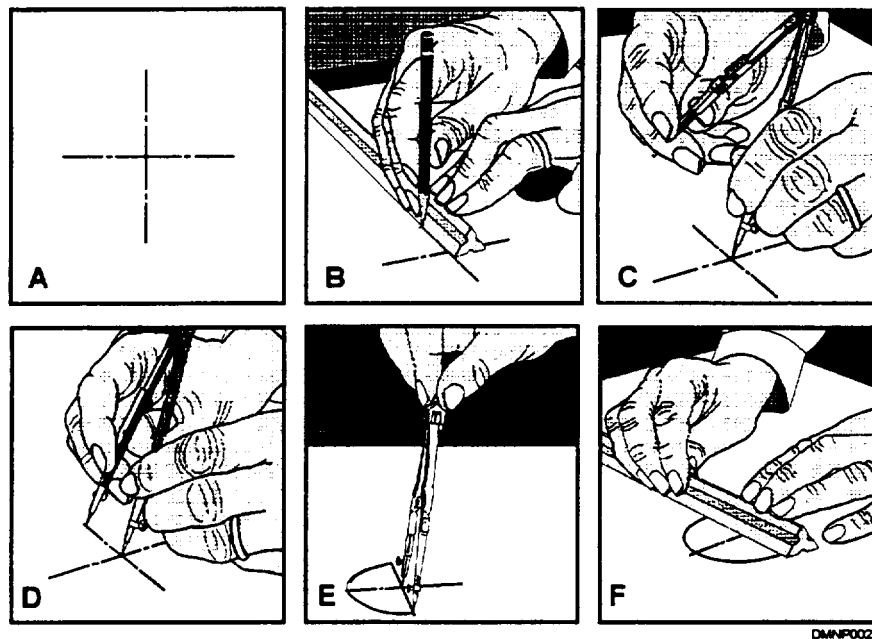
## Cased Instruments, Continued

### Compasses (Continued)

To use a compass, follow this table:

Step	Action
1	Make sure the needlepoint projects 1/64 inch beyond the nib.
2	Set compass legs to radius of desired circle or arc (Figure C).
3	Place needle carefully in exact center of proposed circle (Figure D).
4	Slowly lower nib to paper.
5	Rotate compass to complete circle (Figure E).
6	Check diameter of circle for accuracy (Figure F).

Figure 2-25 illustrates the steps for drawing a circle.



**Figure 2-25. —A. Determine diameter of circle. B. Draw center lines. C, D, E, and F follow chart.**

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## Cased Instruments, Continued

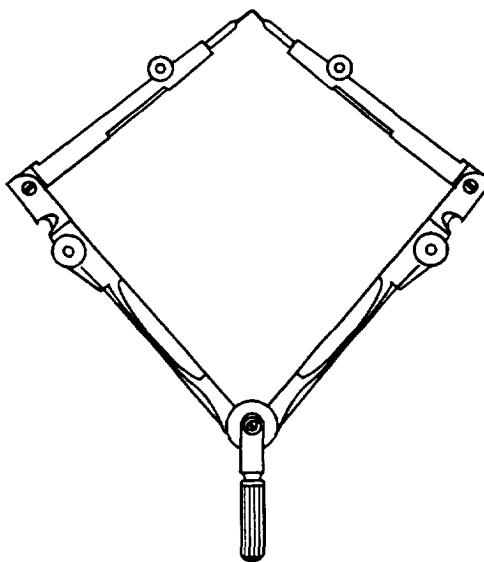
### Compasses (Continued)

Protect the compass needle with cork or eraser bits. Periodically check the leg alignment. Keep the pen clean and free of ink buildup. Wipe the compass with a light oil cloth and return it to the case. Do not oil the joints.

To check compass alignment, follow this table:

Step	Action
1	Spread legs on compass.
2	Bend joints toward center.
3	Needle and nib should touch.

Figure 2-26 illustrates a test for alignment of the compass legs.



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**Figure 2-26. —Testing a pivot joint  
compass for alignment.**

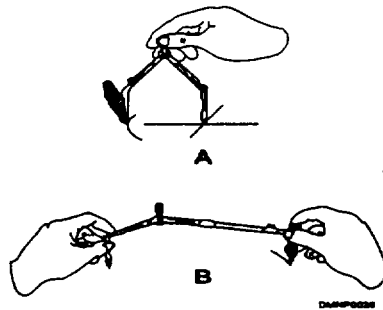
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## Cased Instruments, Continued

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**Extension bars** Extension bars extend the range of a compass so you can draw larger circles. Care for an extension bar as you would any other cased instrument.

Figure 2-27 shows a compass with and without an extension bar.



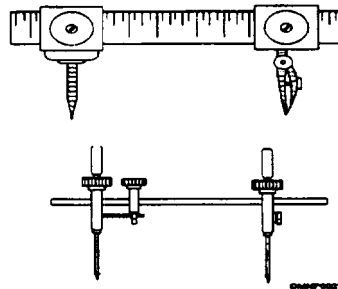
**Figure 2-27. —A. A standard length compass. B. A standard compass with an extension bar.**

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### Beam compasses

Draw an extremely large circle and arcs with a beam compass. The length of the beam that attaches the nibs and needle is the only limitation in the size of the radius of an arc or diameter of a circle. There are several styles and levels of sophistication. Care for a beam compass as you would any other cased instrument.

Figure 2-28 shows two types of beam compasses.



**Figure 2-28. —Beam compasses.**

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## Special Cased Instruments

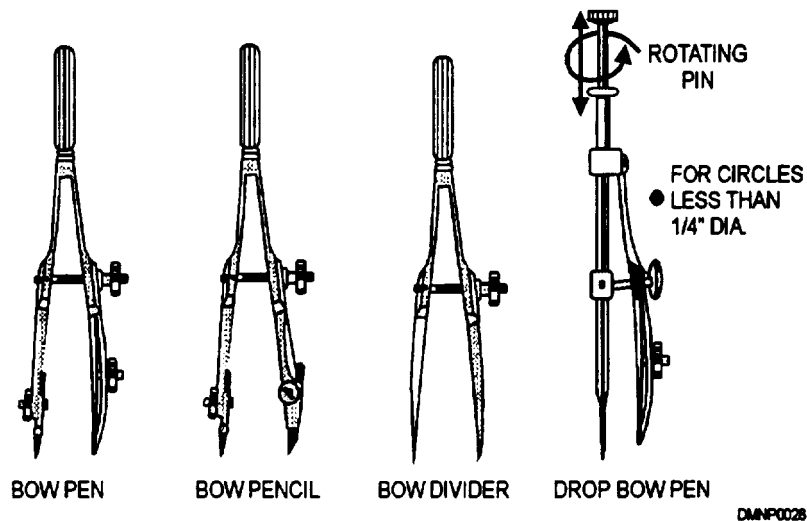
### Introduction

Special cased instruments are uncommon drawing tools used for distinct purposes. They are more delicate than standard cased instruments,

### Bow instruments

For drawing circles and arcs that are less than 1 inch in diameter, use bow instruments. These delicate instruments have a side thumbscrew adjustment that controls the diameter of the circle. There are primarily four types of bow instruments. They are a bow pen, a bow pencil, a bow divider, and a special tool, called a drop bow pen. A drop bow pen is for drawing circles and arcs less than one fourth-inch in diameter. It has a rotating center shaft that moves up and down to minimize motion during drawing.

Figure 2-29 shows bow instruments.



**Figure 2-29. —Bow instruments.**

Keep bow instruments clean and free of debris. Do not store dirty pen nibs. Wipe bow instruments with a light oil cloth and store them in the case when they are not in use.

*Continued on next page*

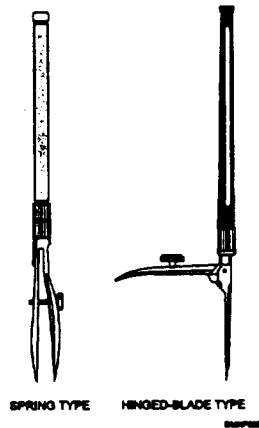
## Special Cased Instruments, Continued

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### Ruling pens

Ruling pens have a nib adjustment that is either the spring-type or the hinged-blade type. The three types of ruling pens you will see in Navy shops are the detail pen, the contour pen, and the railroad pen.

Figure 2-30 illustrates the differences between the two types of nib adjustments.



**Figure 2-30. —Nib types.**

**DETAIL PEN:** The detail pen is sometimes called the “swede” pen. It has broad nibs to handle a greater ink capacity. It can also handle a heavier bodied ink.

Figure 2-31 shows a swede pen with typically broad nibs.



**Figure 2-31. —Detail or swede pen.**

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*Continued on next page*

## Special Cased Instruments, Continued

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### Ruling pens (Continued)

**CONTOUR PEN:** A contour pen lends itself to freehand, curvilinear lines. The pen nib swivels on a shaft inside a hollow handle. It draws sharp, precise lines and the line width is adjustable.

Figure 2-32 shows a contour pen.



**Figure 2-32. —A contour pen with rotating handle.**

**RAILROAD PEN:** Drawing parallel lines of equal or differing width is easy with a railroad pen. Both nibs have adjustable widths. The nibs may or may not rotate on a shaft inside a hollow handle.

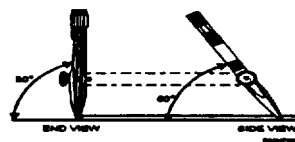
Figure 2-33 shows a railroad pen.



**Figure 2-33. —A railroad pen with rotating handle.**

When you use a ruling pen, maintain perpendicularity with the drawing surface and draw the line with the pen at a 60-degree angle toward the direction the line is being drawn. Clean the pens and wipe them with a light oil cloth before you store them.

Figure 2-34 illustrates the drawing nib angle to paper.



**Figure 2-34.**  
**—Drawing lines with a pen.**

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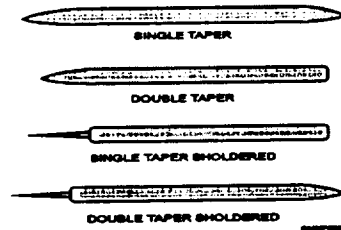
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## Special Cased Instruments, Continued

### Needlepoints

Needlepoints provide a stable pivot point for compasses and dividers to rotate around while you use them. Needlepoints are either tapered, shouldered, or a combination of the two.

Figure 2-35 shows the different combinations of needlepoints.



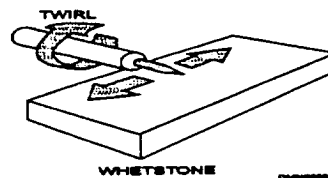
**Figure 2-35. —Needle points.**

Protect needlepoints when they are not in use and sharpen them when necessary.

To sharpen needlepoints, follow this table:

Step	Action
1	Wet one edge of the oilstone and place the needle shoulder against the edge.
2	Twirl between thumb and forefinger.
3	Stroke back and forth on oilstone while twirling.

Figure 2-36 illustrates the shaping of a compass needle.



**Figure 2-36. —Shaping a compass needle.**

*Continued on next page*

## Special Cased Instruments, Continued

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### Center disks

Center disks prevent the enlargement of a hole when concentric circles and arcs are drawn. They are usually very small with a transparent center and three needlepoint legs for holding a position on the drawing surface. Position the center disk carefully on the drawing surface, place the compass needle inside the center of the disk, and rotate the compass to draw concentric circles.

Figure 2-37 shows an enlargement of a center disk.

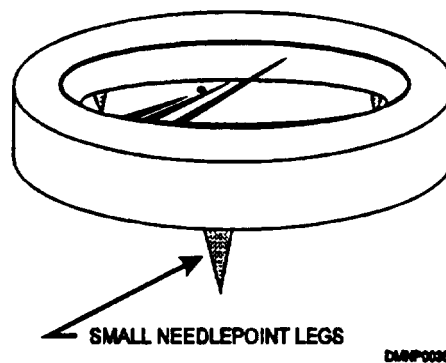


Figure 2-37. —A center disk.

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# Pens

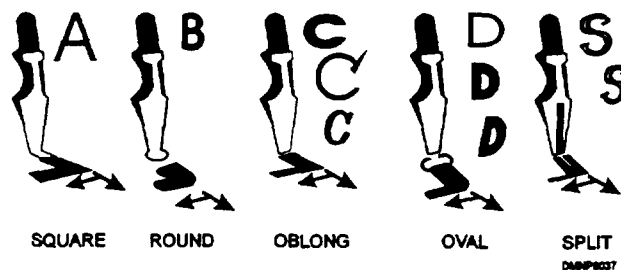
## Introduction

Pens and pen nibs are used throughout Navy drafting shops. The proper care and correct use can prolong the life of a pen nib. Pen nibs are made by many different manufacturers in an endless variety of styles.

## Pen nibs

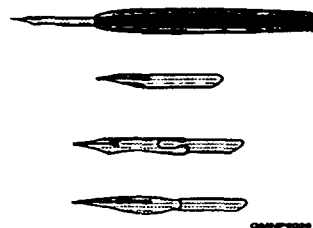
Pen nibs are detachable from a handle or drawing instrument. They may be uniform in shape producing a line of equal width regardless of direction of the stroke, or they may be irregularly shaped to produce a line of unequal width depending on the direction of the stroke. There are pen nibs used exclusively for lettering and nibs used for drawing. Before you use a pen nib, moisten it slightly to remove the manufacturer's protective oil. To fill a pen nib, supply ink by dropper or brush to extend 3/16 inch up the nib blade.

Figure 2-38 shows five different lettering nibs. Notice how changing the direction of the stroke can change the width and character of the line.



**Figure 2-38. -Common nib shapes.**

Figure 2-39 shows quill nibs used for drawing. They have more spring than a lettering nib. Quill pens produce an extremely fine line.



**Figure 2-39. -Quill nibs.**

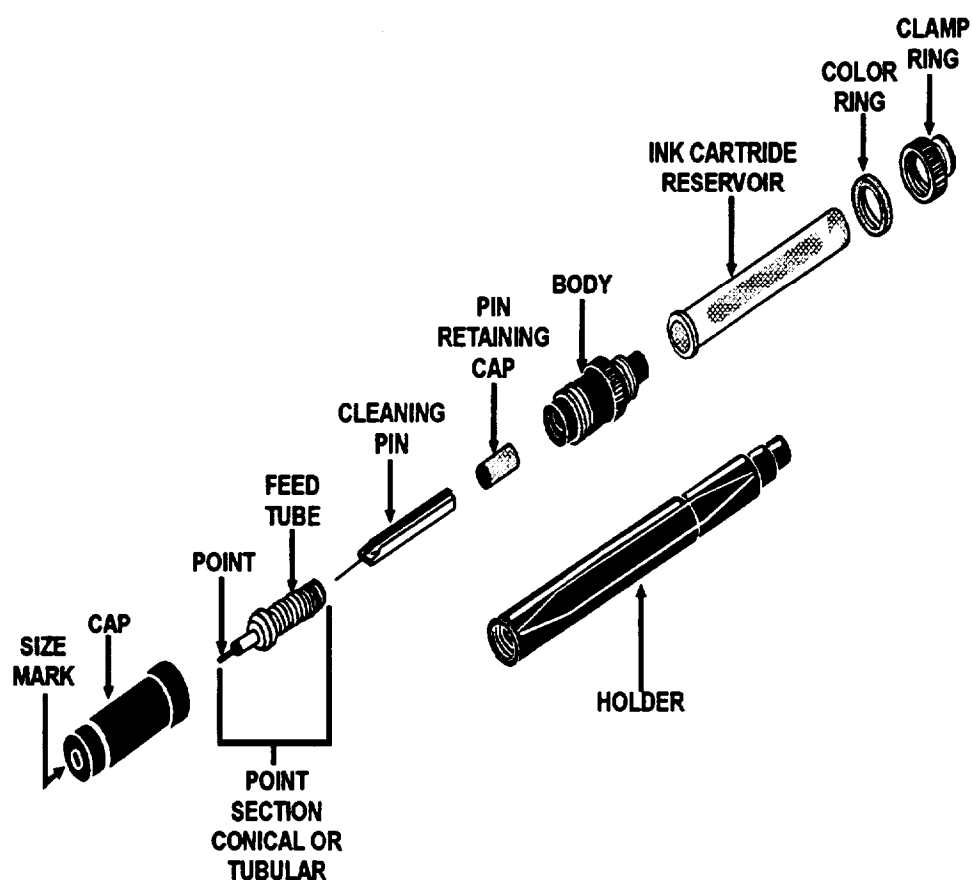
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## Pens, Continued

**Reservior pens** Reservoir pens, sometimes called technical pens, contain their own reservoir of ink. These pens draw lines of uniform width. They have a conical or tubular tip. Tubular tipped reservoir pens can fit into a hand lettering device to do lettering work. Inside the pen there is a weighted needle to regulate ink flow. A penis ready for use when the needle can move freely in the pen.

Figure 2-40 shows an exploded view of a reservoir pen.



DMNP0039

Figure 2-40. —Nomenclature of a reservoir pen.

*Continued on next page*

## Pens, Continued

### Reservoir pens (Continued)

To use a reservoir pen, follow this table:

Step	Action
1	Remove the holder, clamp ring, and ink cartridge reservoir.
2	Fill the reservoir two-thirds full of drawing ink.
3	Holding a tissue over the pen nib, replace the reservoir, clamp ring, and holder.
4	Gently shake the pen up and down away from drawing surface allowing the weighed needle to feed ink into the feed tube.
5	Moisten a tissue and touch the pen nib to it until ink appears.
6	Hold the pen between thumb and forefinger perpendicular to drawing surface.
7	Keep tissue near to remove excess ink and paper fibers from nib as necessary.

Figure 2-41 illustrates a correctly held reservoir pen.

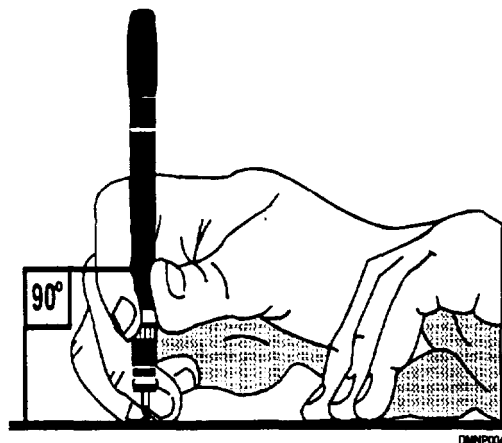


Figure 2-41. —Holding a reservoir pen.

*Continued on next page*

## Pens, Continued

### Reservoir pens (Continued)

Figure 2-42 illustrates the consequences of improper pen handling.

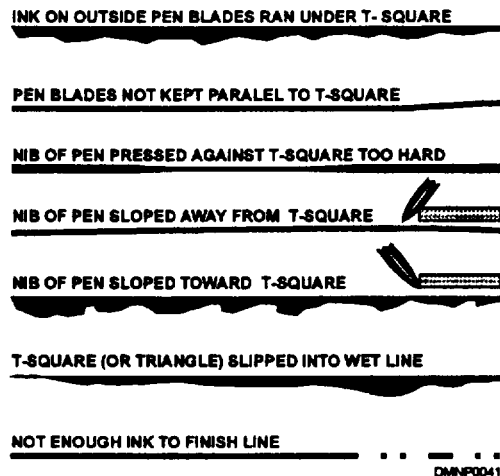


Figure 2-42. —Defective ink lines.

### Pen care

Pen nibs and reservoir pens must be kept clean. Crusted ink will ruin a drawing that is in progress, rust a nib, and permanently freeze a technical pen. Pen nibs are easily cleaned in warm water with a mild detergent. Use water and ammonia to remove stubborn ink. When you are using an ultrasonic cleanser, do not leave a reservoir pen in the cleanser for a long time. Heat from the vibrating cycles will melt the retaining cap. Before you clean a reservoir pen, consider the following guidelines:

- Ž thoroughly clean the pen before periods of nonuse,
- Ž disassemble the pen only for thorough cleaning, and
- Ž handle all parts carefully.

*Continued on next page*

## Pens, Continued

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### Reservoir pens (Continued)

To clean a reservoir pen, follow this table:

Step	Action
1	Remove the holder, clamp ring, and reservoir cartridge.
2	Empty cartridge, rinse, and set aside to dry.
3	Remove the cap, rinse, and set aside to dry.
4	Loosen point section before soaking:  Ž do not force point section loose and Ž allow to soak and renew attempt to loosen.
5	Soak pen in water and ammonia or mild detergent.
6	Rinse well.
7	Thoroughly dry pen parts before reassembly.

When you use an ultrasonic cleanser, do not allow the pen to remain in the cleanser while the cleanser is on for a long period of time. Heat created by the vibration will melt the small plastic parts of the pen.

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# Drawing Aids

## Introduction

Lettering aids, triangles, protractors, anything that helps the draftsman create an image, is a drawing aid. Some shops are fortunate enough to give each worker a set of drawing aids. Other shops have to share equipment among the workers. If your shop shares equipment among the workers, put the gear away clean and in good repair. Keep uncommon tools in commonly accessible places.

## General care

Most drawing aids are made of plastic. Hang up drawing aids or store them flat when they are not in use. Never cut against the edges of a drawing aid or use them as a scraper. When a drawing aid is warped, nicked, out of true, or broken, throw it away and get another.

## Triangles

Use triangles to draw lines at various inclines to the horizontal. Two common triangles are the 30/60-degree and the 45-degree triangle. Both of these triangles have a 90-degree base angle. A combination of a 30/60- and a 45-degree triangle creates eleven other angles. Triangles may or may not have an ink riser to prevent the flow of ink under the triangle edge. Plastic triangles are the easiest to use because you can see the work through them.

Figure 2-43 illustrates the angles created when you use combinations of a 30/60- and a 45-degree triangles.

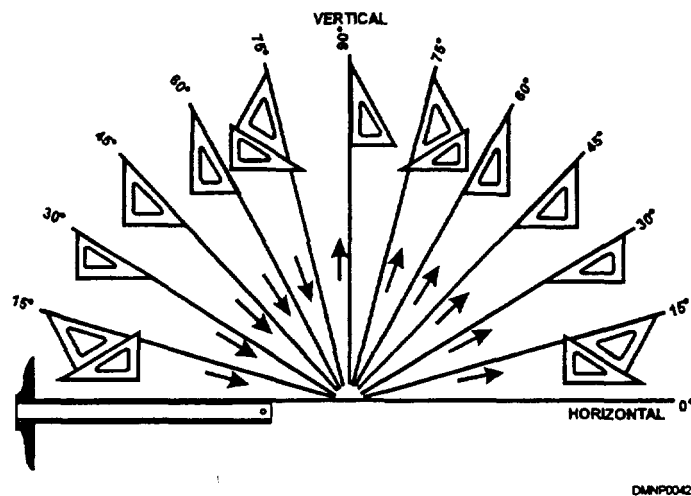


Figure 2-43. —Common angle combinations.

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## Drawing aids, Continued

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### Triangles (continued)

Figure 2-44 shows two standard triangles.

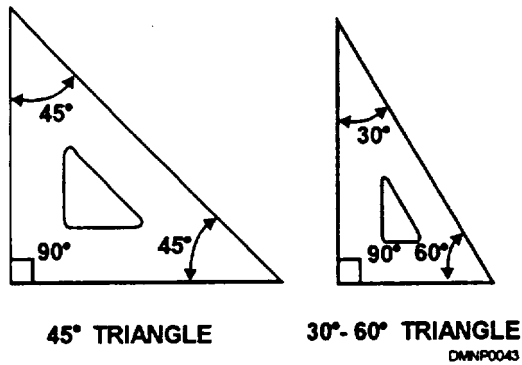


Figure 2-44. —Drafting triangles.

### Adjustable triangles

Use an adjustable triangle for drawing lines inclined at irregular angles to the horizontal. This type of triangle has a set of scales for measuring off an angle and a thumbscrew for setting the angle. Care for an adjustable triangle as you would other triangles.

Figure 2-45 shows an adjustable triangle.

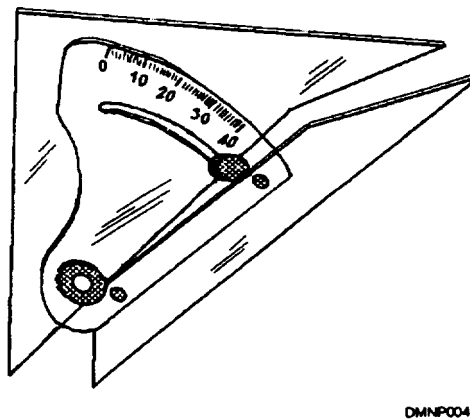


Figure 2-45. —An adjustable triangle.

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## Drawing Aids, Continued

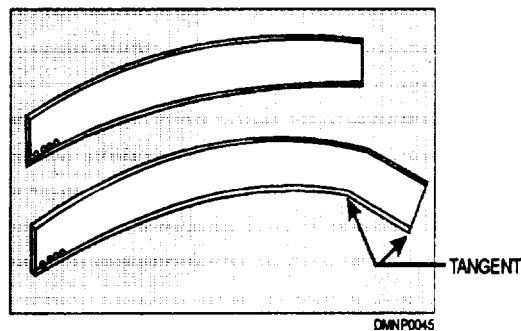
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### Irregular curves

The two types of irregular curves common to a Navy Graphics shop are radius curves, sometimes called railroad curves, and french curves.

**RADIUS CURVES:** Radius curves are used for drawing large arcs. The radius of these arcs are from 1 1/2 to 1,000 inches. Some radius curves have a flat segment on one end, called a tangent.

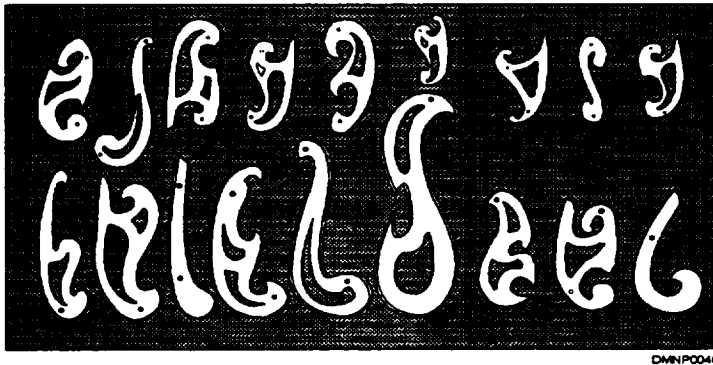
Figure 2-46 shows radius curves.



**Figure 2-46. —Radius curves.**

**FRENCH CURVES:** Use a french curve for drawing irregular or noncircular curves. Some french curves have an ink riser as part of their design. If your french curves do not have an ink riser, put one on with masking tape.

Figure 2-47 shows typical shapes for french curves.



**Figure 2-47. —French curves.**

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*Continued on next page*

## Drawing aids, Continued

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### Special irregular curves

In general, special irregular curves are curves not common to a Navy Drafting shop. These include ship's curves, mechanical engineer's curves, conic sections, and logarithmic spiral curves.

**SHIP'S CURVES:** These curves are peculiar to ship building. They are elongated curvilinear shapes in a variety of sizes.

Figure 2-48 shows ship's curves.



**Figure 2-48.**  
**—Ship's curves.**

**MECHANICAL ENGINEER'S CURVES:** Irregular noncircular curves are drawn with mechanical engineer's curves. These curves are very similar to french curves.

**CONIC SECTIONS and LOGARITHMIC SPIRAL CURVES:** These curves are rarely found in a Navy Drafting shop.

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### Flexible curve rules

This unusual rule is used for drawing irregular curves. Completely flexible, most bend to a minimum radius of 2 inches. They have a metal or lead core which makes them bendable to any desired shape. Some have clear plastic edges graduated in increments.

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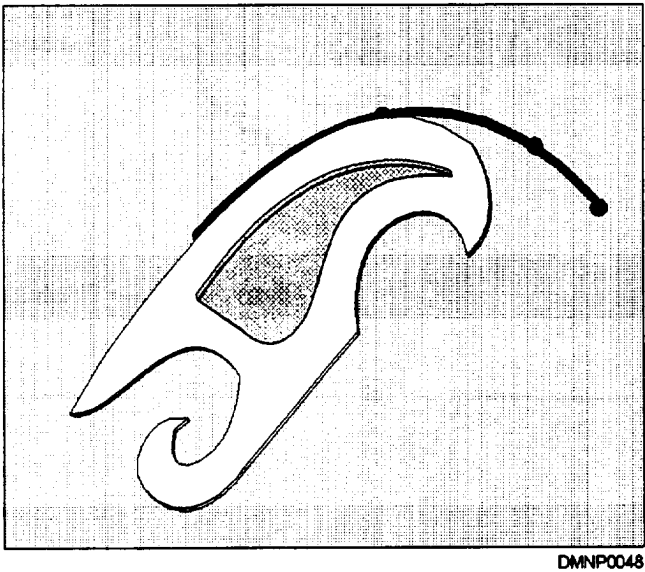
# Drawing Aids, Continued

**Using a  
drawing aid**

To use an irregular curve, special irregular curve, or a flexible curve rule, follow this table:

Step	Action
1	Sketch light freehand lines of the desired curve.
2	Divide the line along its length with a series of points.
3	Select a section of curve that corresponds to at least three consecutive points.
4	Draw curve from point A to point B stopping short of point C.
5	Move curve to next segment.
6	Extend line as before continuing until the line is complete.

Figure 2-49 illustrates using a french curve.



**Figure 2-49. —Using a french curve to draw a curved line through plotted points.**

*Continued on next page*

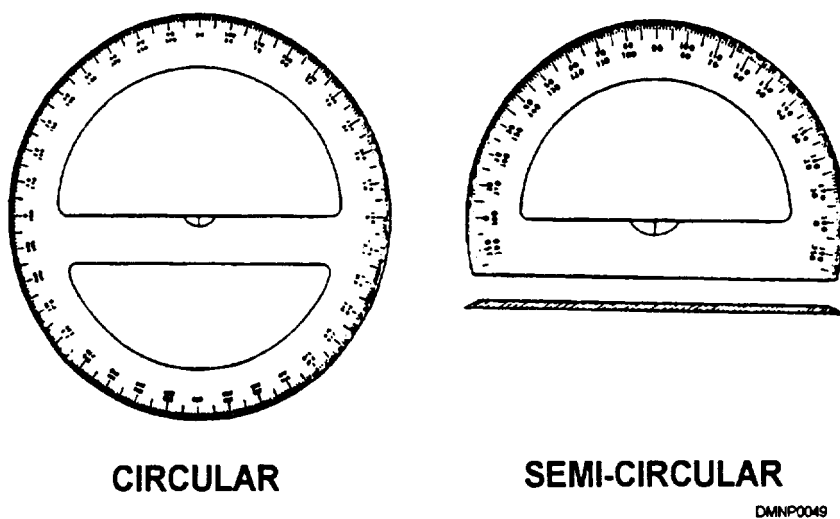
## Drawing Aids, Continued

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### Protractors

To measure and lay off angles from the horizontal without triangles, use a protractor. A protractor may be circular or semicircular. Circular protractors are labeled in quadrants from 0 to 90 degrees or double numbered from 0 to 360 degrees. Semicircular protractors are double numbered from 0 to 180 degrees. Graduations in one-half degree increments allow accurate angle protraction.

Figure 2-50 shows a circular and semicircular protractor.



**Figure 2-50. —Protractors.**

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## Drawing Aids, Continued

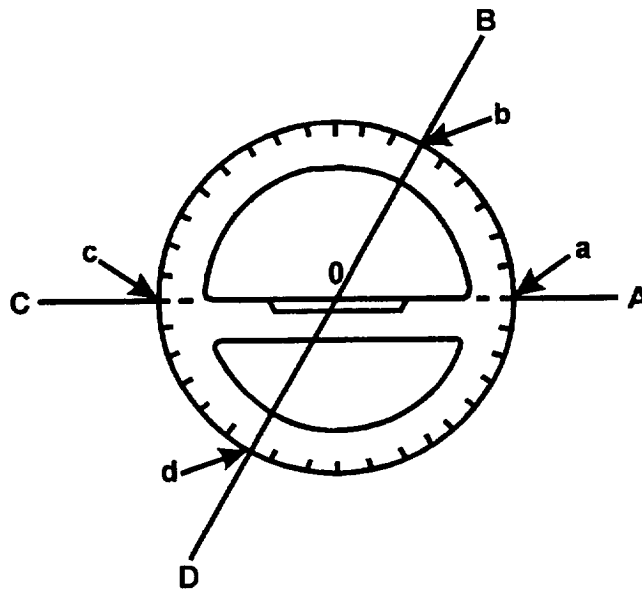
### Protractors (Continued)

To use a protractor for laying off or measuring angles, follow this table:

Step	Action
1	Place the protractor along a straight line CA.
2	Place the 0 degree mark at the vertex of the desired angle.
3	Locate the desired angle (b) and its corresponding complement (d).
4	Draw line BD.

Using four points of reference decreases the possibility of error in measurement.

Figure 2-51 illustrates the stability of a four-point reference system.



DMNP0050

**Figure 2-51. —Protracting an angle using four-point reference.**

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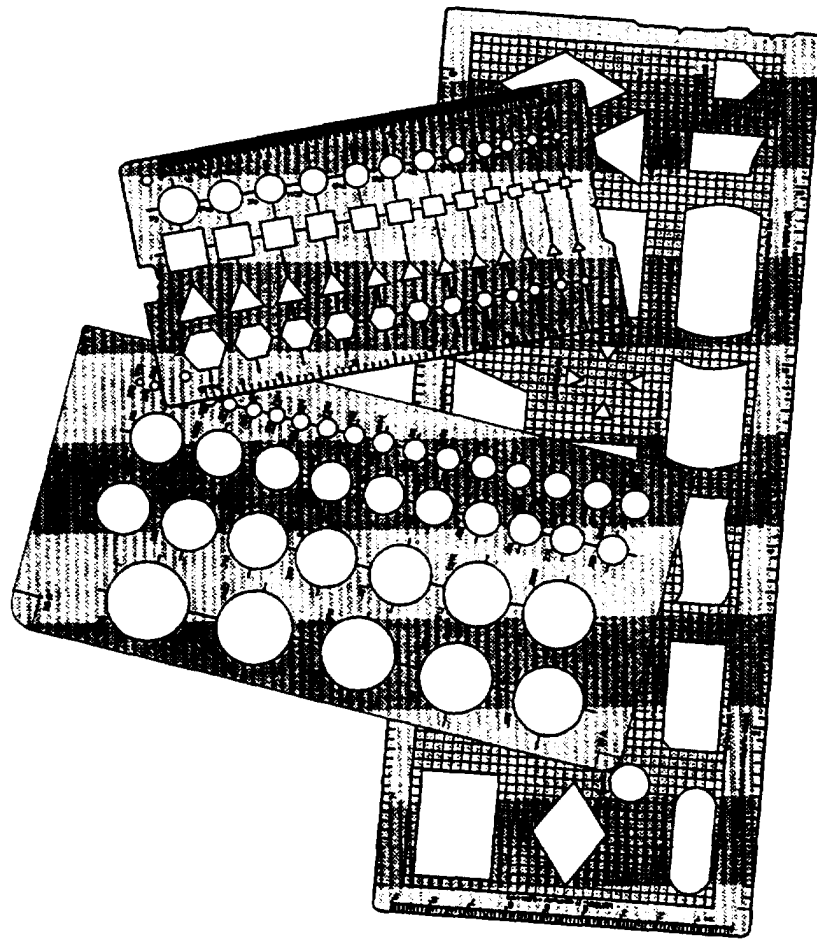
## Drawing Aids, Continued

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### Templates

Frequently drawn symbols are drawn with the aid of a template. Templates are thin plastic sheets with symbols and shapes cut out. Usually transparent, they are available in a great variety. Keep templates clean and back them up with an ink riser if they do not have one.

Figure 2-52 shows a collage of templates by several manufacturers.



DANP0051

**Figure 2-52. —Templates.**

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## Drawing Aids, Continued

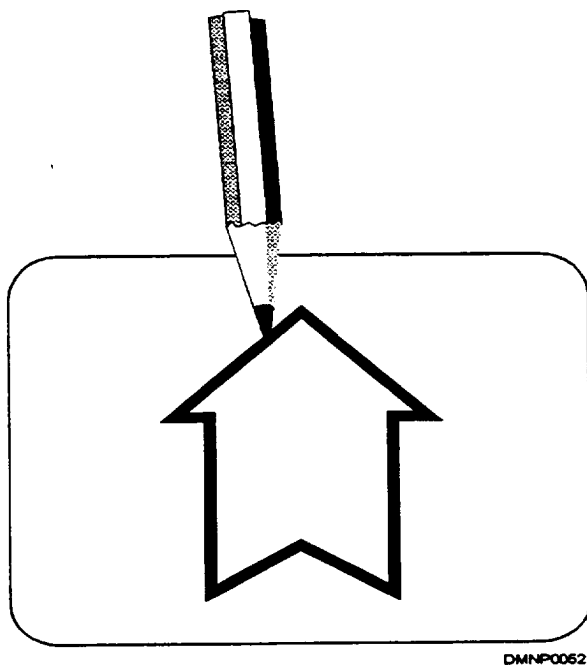
### Handmade templates

Sometimes DMs require a symbol repeatedly and there is not a template manufactured for it. In this case, a DM will have to make one. Medium to heavy acetate, sheet metal, or cardboard will suffice as template material.

To make a template, follow this table:

Step	Action
1	Draw symbol one pencil width larger than desired dimension.
2	Use a sharp blade to cut outline.
3	Clean edges with sandpaper, taking care not to enlarge symbol unnecessarily.

Figure 2-53 shows a template in the drawing stage.



DMNP0052

**Figure 2-53.** —Draw symbol one pencil width larger than desired dimension.

*Continued on next page*

## Drawing Aids, Continued

### Ink risers

The purpose of an ink riser is to raise the drawing aid slightly off the drawing surface so that ink will not bleed underneath it. If you do much ink work, put ink risers on the back of the drawing aid you use most frequently.

To make an ink riser, follow this table:

Step	Action
	Clean the back of the drawing aid.
2	Evenly cover the back with masking tape, taking care not to overlap tape.
3	Add a second layer of tape at right angles to the first layer.
4	With a fresh, sharp blade, cut openings approximately 3/32" larger than the openings of the template or the edge of the triangle or curve.
5	Remove unwanted tape.
6	Periodically clean riser and remove and replace as necessary.

Figure 2-54 shows a 30/60-degree triangle with an ink riser of masking tape.

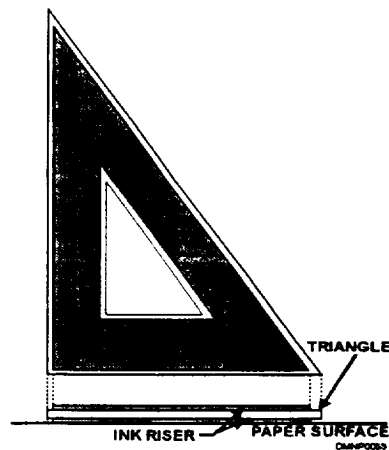


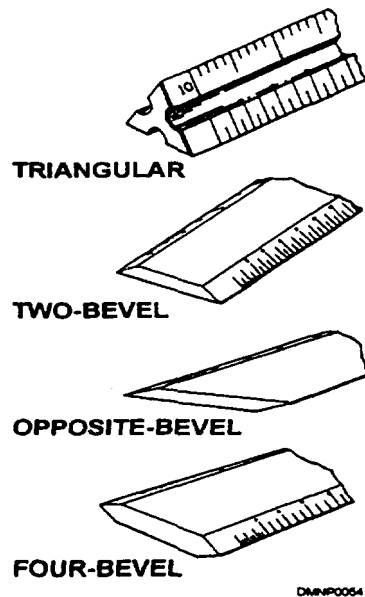
Figure 2-54. —Triangle with an ink riser.

# Scales

## Introduction

Scales measure increments. The most common shaped scales are the triangular, two-bevel, opposite-bevel, and four-bevel. They vary not only in shape, but in style, division, and type. When properly cared for, scales will last a lifetime. Never rap a scale on a table or hard edge. Do not cut or draw lines against the machined increments of a scale face.

Figure 2-55 shows the most common scale shapes.



**Figure 2-55. —Common scale shapes.**

## Triangular scales

Triangular scales provide six scale faces on one rule. Each scale face is double numbered except for the 16 scale which stands alone. This gives the DM eleven scales with which to measure. The triangular scale is convenient for most drawings. Some triangular scales have scale clips to identify the scale in use. Scale clips also ensure that the correct side of the scale is against the drawing surface. Large paper binder clips are a suitable substitute for scale clips.

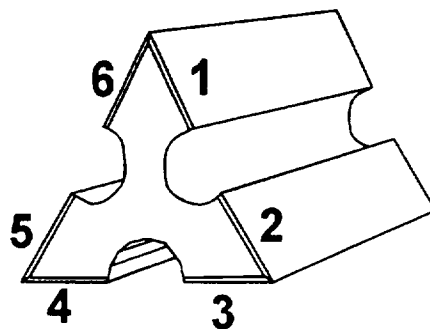
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## Scales, Continued

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### Triangular scales (Continued)

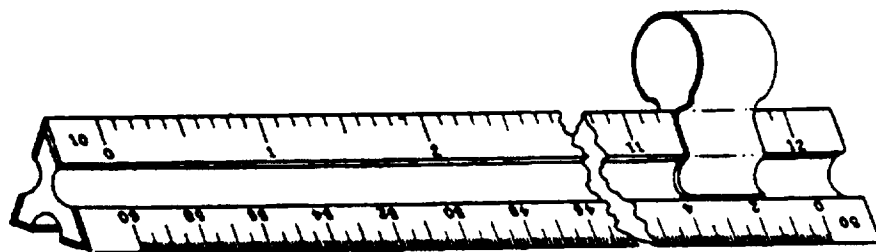
Figure 2-56 shows six scale faces on one rule.



DMNP0055

**Figure 2-56. —A triangular scale has six faces.**

Figure 2-57 shows a scale clip.



DMNP0056

**Figure 2-57. —Triangular scale with a scale clip.**

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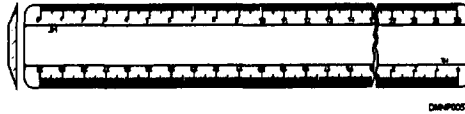
## Scales, Continued

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### Two-bevel scales

Two-bevel scales tend to be wide-based. The two scale faces are always visible.

Figure 2-58 shows a two-bevel scale.



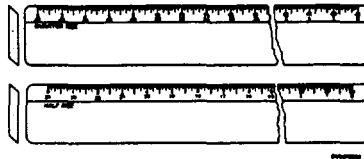
**Figure 2-58. —Two bevel scale.**

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### Opposite-bevel scale

There are two scale faces on an opposite-bevel scale, but only one scale face is visible at a time. Because the sides of this scale are beveled, it is easy for you to remove it from the drawing surface.

Figure 2-59 shows an opposite-bevel scale.



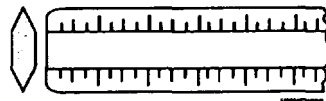
**Figure 2-59. —Opposite bevel scale.**

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### Four-bevel scale

There are four scale faces on one rule on a four-bevel scale. Both edges on both sides are beveled. This type of scale is usually found as a small pocket scale particularly for machinists.

Figure 2-60 shows a four-bevel scale.



**Figure 2-60. —Four bevel scale.**

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## **Scales, Continued**

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<b>Division</b>	Scales are either engine divided or stenciled/painted. Engine division is highly accurate and etched into the scale face. Stenciled or painted increments are less accurate and easily worn away.
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<b>Division style</b>	<p>A DM must know four terms relating to the way in which increments are displayed on a scale that a DM must know. These are open divided, fully divided, double numbered, and single numbered.</p> <p><b>OPEN DIVIDED:</b> On an open divided scale, only the main increments are shown. There is one fully subdivided increment on the end of the scale to the left of the 0 point. Measurements of full units are read from the right of the 0, while partial increments are left of the 0.</p> <p><b>FULLY DIVIDED:</b> All increments on a fully divided scale are shown. This makes it easier to use, but not easier to read.</p> <p><b>DOUBLE NUMBERED:</b> The convenience of a double-numbered scale are that it reads from left to right and from right to left, allowing two different scales to appear on the same scale face.</p> <p><b>SINGLE NUMBERED:</b> This is by far the easiest scale division to read because there is only one scale per face, and it is usually fully divided.</p>
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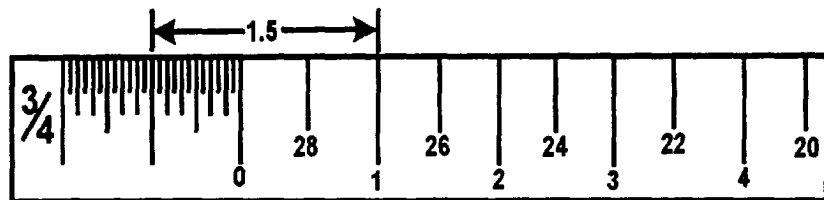
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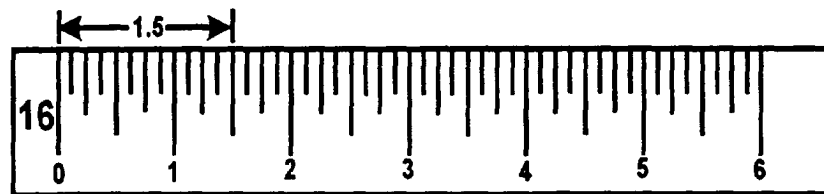
## Scales, Continued

### Division style (Continued)

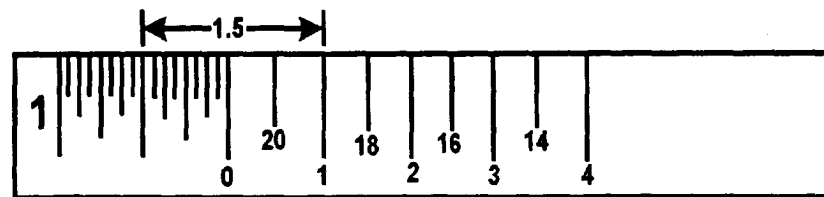
Figure 2-61 illustrates how different 1 1/2 inches appear on differing scale faces.



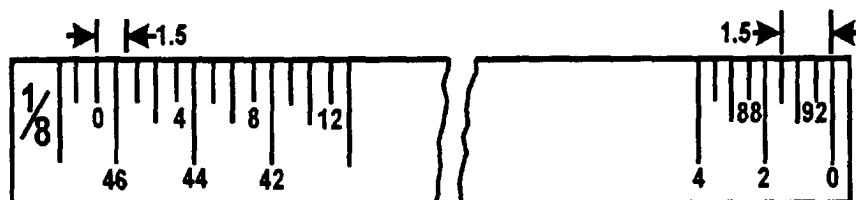
OPEN DIVIDED



FULLY DIVIDED



SINGLE NUMBERED



DOUBLED NUMBERED

DMNP0080

Figure 2-61. —Incremental divisions.

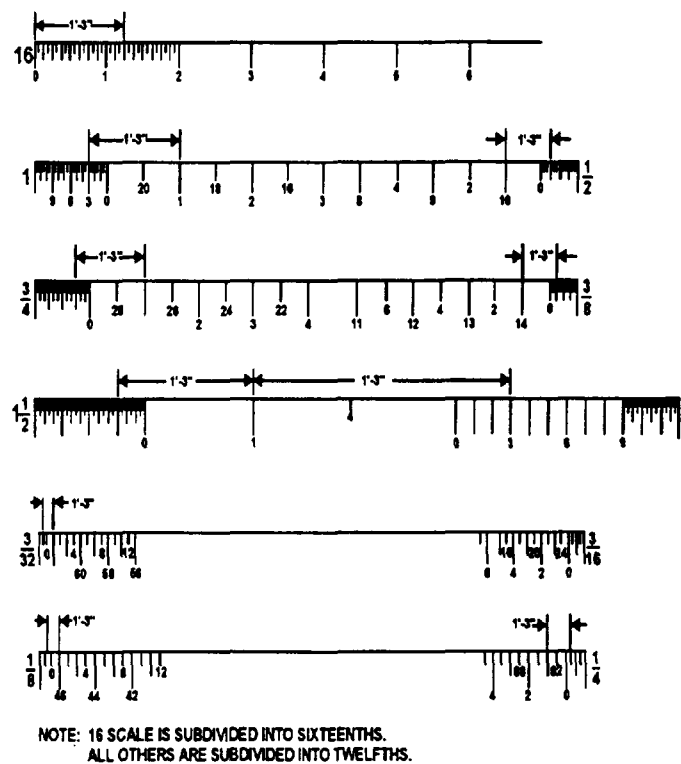
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## Scales, Continued

**Types of scales** Architect scales are the most common in a Navy Drafting shop, followed by the chain or civil engineer's scale. Mechanical engineer's scales are also found in some shops.

**ARCHITECT'S SCALE:** This scale is the most common because it measures increments in terms of feet and inches. It has eleven scales on six scale faces. All scale faces are double numbered except for the 16 scale which stands alone. The 16 scale equates to a standard ruler. The architect's scale is open divided with the fully subdivided increment divided into 12 (inches). Lay off feet using the main scale to the right of the 0 mark. Lay off inches from the subdivided increment to the left of the 0 mark.

Figure 2-62 shows the scales on an architect's scale.



DMNP0001

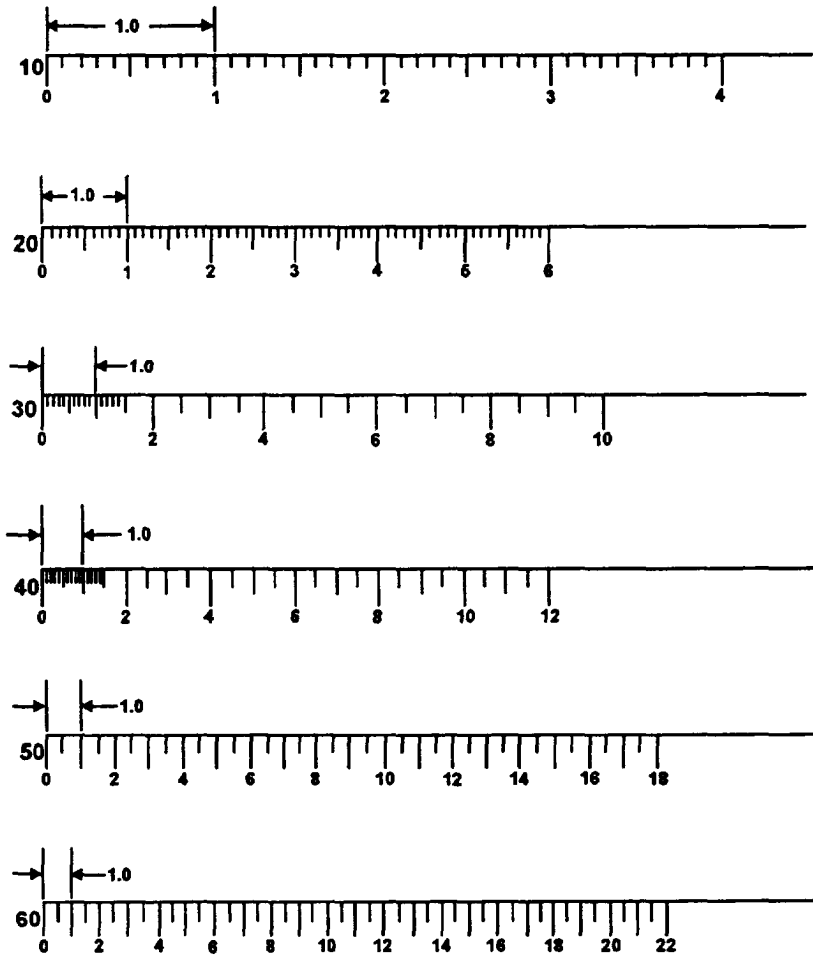
**Figure 2-62. —Faces on an architect's scale.**

*Continued on next page*

## Scales, Continued

**Types of scales** CHAIN or CIVIL ENGINEER'S SCALE: This scale is ideal for graphs. It may represent any measurable quantity in multiples of 10. It has six scale faces fully divided into decimal units.

Figure 2-63 shows scales from a chain or civil engineer's scale.



NOTE: EACH SCALE REPRESENTS ANY QUANTIFIABLE ITEM IN MULTIPLES OF TEN.

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Figure 2-63. —Chain or civil engineer's scale.

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## Scales, Continued

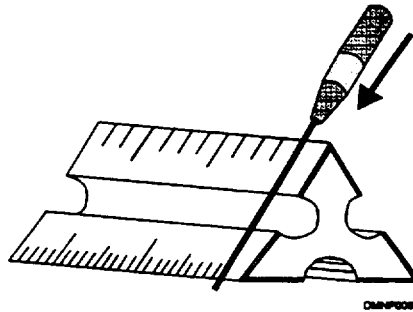
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<b>Types of scales</b>	<b>MECHANICAL ENGINEER'S SCALE:</b> Mechanical engineer's scales are used for small machine parts not less than one-eighth scale. These scales are double-numbered.
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<b>Using the scale</b>	To use any scale, lay the scale on a surface parallel to a line. Use a sharp pencil to mark all measurements before moving the scale. Your moving the scale for each measurement increases the likelihood of a cumulative error. Indicate the measurements with a sharp pencil or pin prick. Do not draw against the machined increments of the scale or use it as a cutting edge.
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Figure 2-64 illustrates the use of a pinpoint to indicate measurements.



**Figure 2-64. —Measuring increments on a triangular scale.**

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<b>Indicating scale</b>	Indicating scale on a drawing expresses the ratio of the item to the drawing. It lends perspective to the viewer by providing a reference point. The three ways to indicate the scale on a drawing are the fractional method, the equation method, and the graphic method.
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**FRACTIONAL METHOD:** The fractional method is indicated by a fraction or ratio. The drawing unit is the numerator and the object is the denominator.

**EQUATION METHOD:** Scale indicated by feet and inches is the equation method of indicating scale. Feet are followed by a single apostrophe (') and inches are shown with a double apostrophe (").

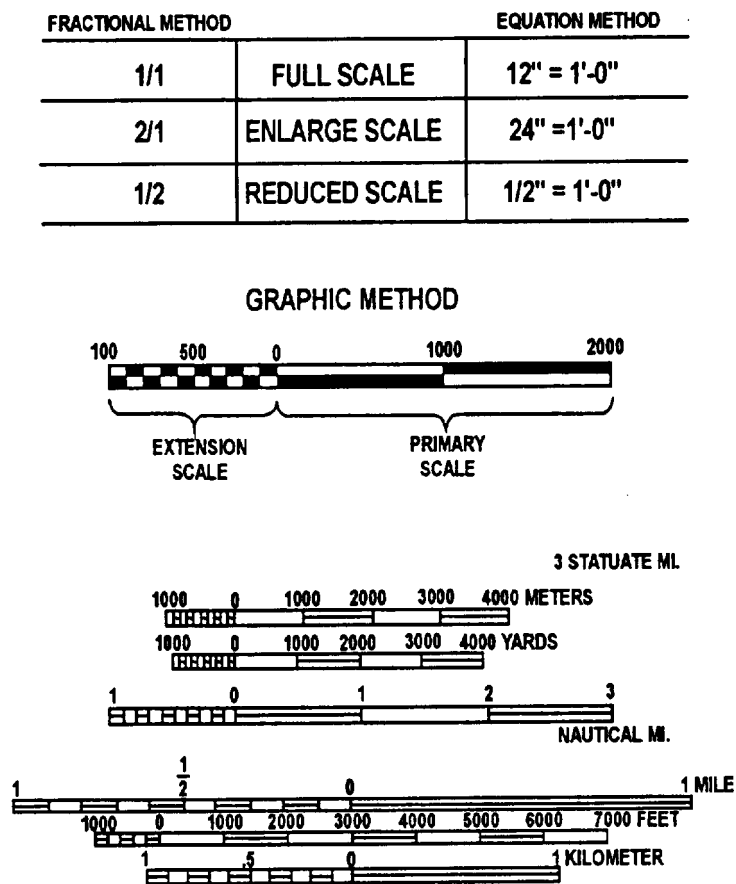
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## Scale, Continued

**Indicating scale (Continued)** GRAPHIC METHOD: An actual scale is drawn in the graphic method of showing the scale on a drawing. This is done on maps. The primary scale is to the right of the 0 and a subdivided scale is to the left of the 0.

Figure 2-65 illustrates the three ways of indicating scale on a drawing.



DMNPO084

Figure 2-65. —Indicating scale.

## Brushes

### Introduction

It is important to have good quality brushes in the shop. We will cover two types of brushes which are general-purpose brushes and paint brushes.

### General-purpose brushes

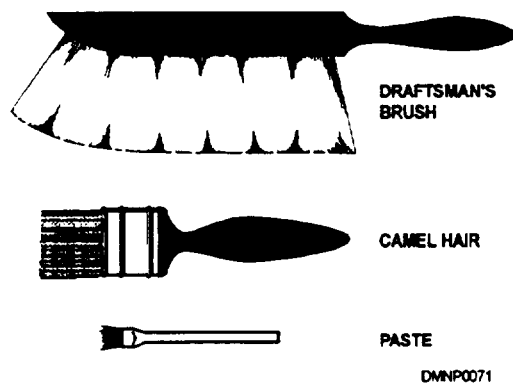
Keep shop brushes clean and free of abrasive particles that may scratch surfaces when you use them. Use the brush for its intended purpose. Do not whisk your drafting table with a brush just used to pickup dirt from the deck during field day.

**DRAFTSMAN'S BRUSHES:** Draftsman's brushes clean away dust and debris from working surfaces. They should not be overly abrasive as you will be whisking this brush over work in progress.

**CAMEL HAIR BRUSHES:** Camel haired brushes clean mirrored surfaces, camera lenses, and keyboards. They should be of a high quality soft bristle to prevent scratching optical surfaces.

**PASTE BRUSHES:** Use paste brushes to apply glues and for general-purpose work. They may be cheaper in quality, as most of these brushes are disposable.

Figure 2-66 shows the profile of common shop brushes.



**Figure 2-66. —Common shop brushes.**

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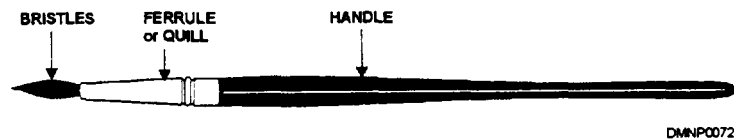


## Brushes, Continued

### Paint brushes

Lettering, illustrations, and painting are done with paint brushes that vary in composition but have similar physical characteristics. All brushes have bristles, a ferrule or quill, and a handle. Choice of bristle depends on the intended use or desired effect. The size of the ferrule or quill dictates brush size and holds the bristles tightly in place, and the handle, usually made of hardwood, indicates the size of the brush.

Figure 2-67 shows brush nomenclature.

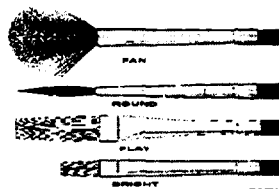


**Figure 2-67. —Brush nomenclature.**

### Shapes of a paint brush

There are four major shapes to paint brushes: fan, round, flat, and bright. The fan shape feathers paint over a surface and responds well to a light touch. The round shape is most commonly used for watercolor because it picks up and retains more pigment and water. Bristles on the flat and bright will differ according to the type of pigment used but tend to be a stiffer more controllable brush.

Figure 2-68 shows the shape of common paint brushes.



**Figure 2-68. —Brush shapes.**

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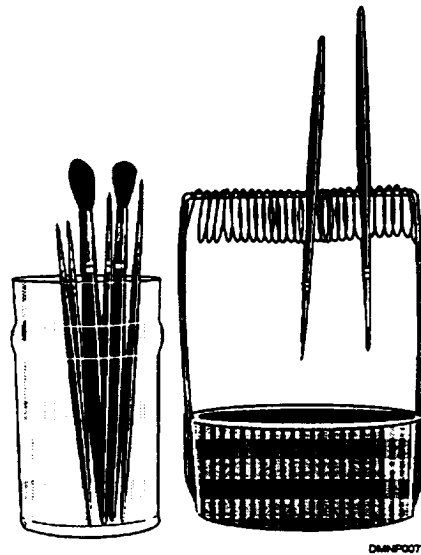
## Brushes, Continued

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### Storage

Store brushes in a clean condition and in the upright position. Never allow a brush to dry or set on its bristles. This permanently curls the bristles and ruins the brush for further use. Use a glass, a mug, or a brush holder to store brushes when they are not in use.

Figure 2-69 shows correctly stored brushes.



**Figure 2-69. —Store brushes.  
correctly.**

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### Brush hair

The choice of a brush depends on the intended use, the desired effect, and the nature of the pigment. Many types of natural and synthetic bristles or hair are available in all shapes. Your creativity will dictate selection of the appropriate brush; however, the novice should follow these guidelines for red sable, camel hair, and ox hair.

**RED SABLE:** True red sable is the most desirable brush to use. Use it primarily for watercolor and washes. It has a great capacity for holding pigment and water while retaining a spring in the bristles. Red sable brushes are very responsive when used with water soluble pigments. They become less responsive with heavy bodied pigments, such as oil and acrylic.

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## Brushes, Continued

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### Brush hair (Continued)

**CAMEL HAIR:** Camel hair is a mixture of squirrel, skunk, badger, and pony hair. These brushes are extremely soft and have less spring in the bristles than red sable. Camel hair brushes with very long bristles letter well on smooth surfaces. Pin stripes are made by a camel hair dagger brush. Camel hair brights and flats are used for oil and acrylic paint.

**OX HAIR:** Ox hair brushes are strong bristled brushes. These coarse bristles are made into flats and brights. Use ox hair brushes to do rigid lettering and for painting with oils and acrylics.

**SYNTHETIC HAIR:** Synthetic fiber hair is rapidly replacing natural bristles in brush construction. Synthetics have the spring and resiliency to withstand abuse from multi-medium use and chemical cleaners. Fan-shaped brushes most often appear with synthetic bristles. Synthetic bristle brushes work well in any medium.

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### Oil brushes

If you use both water- and oil-based paints, dedicate a set of brushes to oil-based paints only. After cleaning the brushes and before storing them, add a drop of oil to the bristles. This keeps the bristles pliable and lessens the effect of the harsh chemicals used to clean them. Store them in an enclosed container to minimize airborne contaminants. A set of brushes dedicated to oil-based paints will also eliminate the chance of your confusing them with brushes used for water-based paints. Once you use a water-based paint brush in oil-based paints, you should not use it for a water-based pigment again.

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## Brushes, Continued

### Caring for brushes

After using a brush, clean it thoroughly and store it. A brush properly cared for will last many years. Throw away crusted and curled brushes or reuse them as disposable paste brushes.

To clean a brush, follow this table:

Step	Action
1	Remove as much color as possible: Ž use water for water-based paints and Ž use thinner or mineral spirits for oil-based paints.
2	Wet brush in lukewarm water.
3	Lather palm of hand with mild face soap.
4	Stroke brush back and forth in hand.
5	Rinse thoroughly in clean water.
6	Shake excess water from bristles.
7	Shape bristles gently into original shape.
8	Store brushes with bristles up.

# Pencils

## Introduction

A pencil is the most readily available tool for expressing ideas from mind to paper. Limited only by imagination, use a pencil to draw the infrastructure of a drawing or as the finish medium. Some artists specialize in the pencil and its many variations as a form of expression.

## Drawing pencils

For general drawing, sketching, and layout, use a drawing pencil. Drawing pencils have a wood casing around a core of graphite or composite. The composition of the core, called a lead, and the hardness of the lead determine the grade or rating of a pencil.

## General care

Take care not to drop a pencil or rap it against a surface. This will break the lead internally and drastically shorten the life of the pencil. Keep a drawing pencil sharpened by using a sandpaper sharpener, a draftsman's pencil sharpener, or a standard office sharpener.

## Lead hardness

Pencil leads are available in 17 grades from 6B which is the softest to 6H, the hardest. Soft leads are 6B to 2B and have a thick-diameter core. Soft leads are best used in freehand work where smudging is a creative option. Medium-rated leads are the B to 3H pencils. These are general layout pencils sometimes used for freehand work. Technical drawing and drawing that requires a degree of precision are done by hard-leaded pencils in the 4H to 6H range. Hard-leaded pencils have a small-diameter core and tend to appear lighter in density than a soft-leaded pencil. Variations do occur among manufacturers.

Figure 2-70 shows a chart of lead hardness.

SOFT FREE HAND DRAWING					MEDIUM FREE HAND DRAWING AND GENERAL LAYOUT					HARD TECHNICAL DRAWING						
6B	5B	4B	3B	2B	B	HB	F	H	2H	3H	4H	5H	6H	7H	8H	9H

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Figure 2-70. —Lead hardness.

Continued on next page

## Pencils, Continued

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### Lead composition

Lead is made of a composition of substance and binder. The substance of a pencil lead can be graphite, carbon, charcoal, lithographic grease, colored pigment, wax, or pastel. The binder is relatively unimportant unless you are writing on a slick surface. The selection of a pencil lead is a matter of personal preference and creative intent; however, some guidelines do apply.

**GRAPHITE:** Graphite leads leave a dense black line with a shiny surface that can reflect light or glare when photographed for reproduction. As humidity increases, the lead softens and smears easily. In extremely dry conditions, the graphite produces a dusty residue.

**CARBON:** Carbon pencils produce a dense, dull-surfaced black line that is not affected by humidity to the same extent that graphite is. Carbon pencils tend to smear if they are not freed by a commercial fixative.

**CHARCOAL PENCILS:** Charcoal pencils are not always found in a wood casing. Charcoal is available as sticks and in powder form. Charcoal produces a dense, dull black line.

**LITHOGRAPHIC PENCILS:** This pencil produces a dense black line which tends to be greasy. Its primary purpose is marking lithographic plates, but it also marks well on glass and plastics.

**COLOR PENCILS:** In a color pencil, pigment determines the color of the line and binder determines whether it is water soluble or waterproof. Some binders have a waxy binder that makes it difficult to erase or blend them.

**PASTEL PENCILS:** Once available only in stick form, pastels are now in pencil form. The characteristics of the pastel pigment remain the same. In the pastel, the pigment may be dry or oil-based. They leave a dull, chalky line and come in many colors. Pastels more popular form is still in sticks and powder.

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## **Pencils**

### **Special-purpose pencils**

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Special-purpose pencils are those pencils that are nonreproducing or have waxed based cores. Use a nonreproducible blue pencil for layout work intended for black-and-white reproduction. Most black-and-white photographic films are blind to the light sky-blue color and will not record it on the negative. Nonreproducing lithographic pencils are dark violet in color. Used on a lithographic plate, this pencil will not appear in the finished product. Waxed-based leaded pencils, sometimes called china markers, come in a variety of colors and are capable of marking on glass, plastic, and metal surfaces.

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## Basic Consumables

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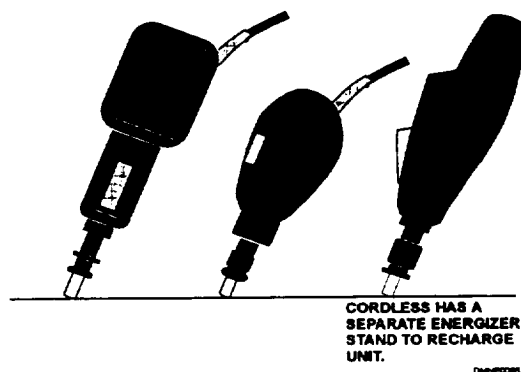
**Introduction** Many things a DM uses in the shop are consumable items. Erasers, pencils, and brushes are used and discarded. These items are underestimated in terms of what they do to ease the work load of the DM.

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**Erasers** There are electric erasers and hand erasers.

**ELECTRIC ERASERS:** Electric erasers are hand-held units with a power cord or rechargeable base. They provide a rapid and thorough erasure. Take care not to hold the eraser in one spot for too long as the rotation of the eraser and heat generated by it will damage the paper surface. Move the electric eraser in a circular motion over the drawing protecting those areas to remain with an erasing shield.

Figure 2-71 shows silhouettes of some popular electric erasers.



**Figure 2-71. —Electric erasers.**

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## Basic Consumables, Continued

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### Erasers (continued)

**HAND-HELD ERASERS:** Hand-held erasers are available in different grades, each with a specific purpose. Hard erasers are a white or grey color and are very abrasive. They remove stubborn marks in pencil or ink. Moderately abrasive erasers are red. Soft erasers remove only light lines, as they are the least abrasive. Soft erasers are pink in color.

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### Types of erasers

Erasers have specific purposes. Besides the pencil eraser, there are four other erasers the DM uses in the work center. These are plastic erasers, art gum, kneaded erasers, and pulverized eraser particles.

**PLASTIC ERASERS:** Plastic erasers work well removing unwanted marks from drawings on Mylar. Moisten the eraser slightly before using to increase the drag on the drawing surface. This eraser leaves no residue.

**ART GUM:** This eraser is excellent for removing finger marks and smudges without marring the surface of a drawing. An art gum eraser leaves much residue which should be whisked away with a draftsman's brush.

**KNEADED ERASERS:** Kneaded erasers bring out the highlights in a drawing and clean a drawing surface. They work by absorbing graphite particles. Absorption increases by kneading the eraser in your hand. Generally, it leaves no residue unless it is too old and/or too full of absorbed particles. If this eraser becomes overly warm, the substance may break down, leaving a stain on the drawing surface.

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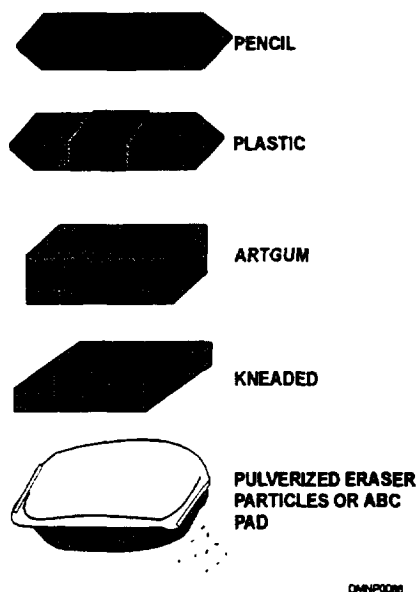
## Basic Consumables, Continued

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### Types of erasers (Continued)

**PULVERIZED ERASER PARTICLES:** Pulverized eraser particles are available as a powder or in a soft mesh bag. They clean a drawing of surface smudges and prepare it to accept ink. Whisk away the residue of eraser particles with a draftsman' brush.

Figure 2-72 shows the types of erasers common to a work center.



**Figure 2-72. -Common  
erasers.**

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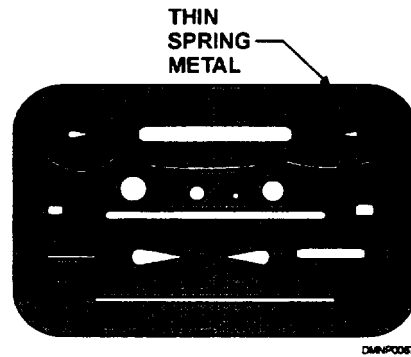
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## Basic Consumables, Continued

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**Erasing shields** Erasing shields protect areas of a drawing that you do not want to erase. They are made of a light gauge, spring metal with numerous openings in variegated shapes and sizes.

Figure 2-73 shows an erasing shield.



**Figure 2-73. —Erasing shield.**

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### Stumps and tortillons

Stumps and tortillons blend pencil, charcoal, pastels, and crayons together in a drawing. They are made of kraft paper twisted tightly into blunt and pointed ends. When they are dirty, throw them away and get a clean one.

Figure 2-74 shows stumps and tortillons.



**Figure 2-74. —Stumps and tortillons.**

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### Cutting mats

Use a cutting mat to cut out items with a blade. They are self-sealing and stabilize the blade during cutting. Keep the cutting mat clean and remove the wax or adhesive buildup often.

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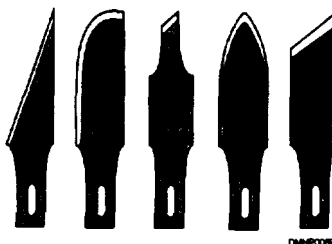
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## Basic Consumables, Continued

### Blades

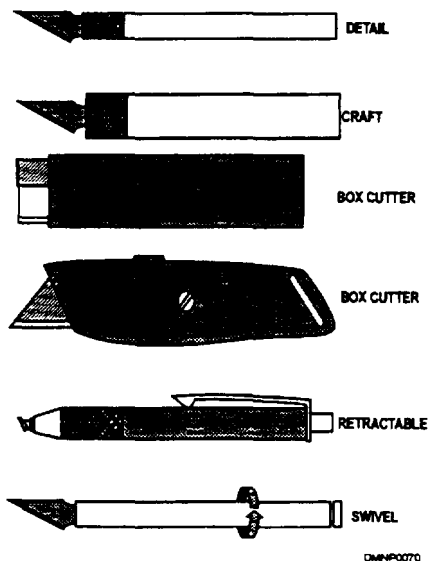
Knives or blades come in an assortment of shapes. Each shape has a specific purpose. Blades normally found in a shop include swivel knives, craftsman knives, and box cutters. Keep a sharp blade in the knife handle. Change blades frequently to ensure a clean cut.

Figure 2-75 shows examples of blades. Let personal preference dictate the blade most comfortable for you,



**Figure 2-75. —Blade shapes.**

Figure 2-76 illustrates knife styles with particular purposes.



**Figure 2-76. —Knife styles.**

## Summary

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### Review

This chapter covered the general types of shop furniture found in a Navy Drafting shop and how to care for it. It described cased and special cased instruments and the procedures to store and use them. Drawing aids and scales are some of the simplest and most worthwhile tools to master. Practice with them. Use the pens and pencils mentioned. Consumable supplies represent the bulk of supplies that you, as a DM, will use. Do not waste supplies needlessly.

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### Comments

Familiarity with any piece of equipment will enable the DM to assess the limitations and capabilities of the shop accurately. Know your equipment well. Care for the equipment in the shop as if it were your own. Maintain an open mind to new products in the market. A good, capable shop enhances the reputation of each worker in it. In a rate as small as DM, that reputation could follow you throughout your career.

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